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MODEL 1200

SEMICONDUCTOR

SLICE PROBER

SERVICE AND MAINTENANCE

MANUAL

SERVICE & MAINTENANCE
MANUAL

MODEL 1200
SEMICONDUCTOR SLICE
PROBER



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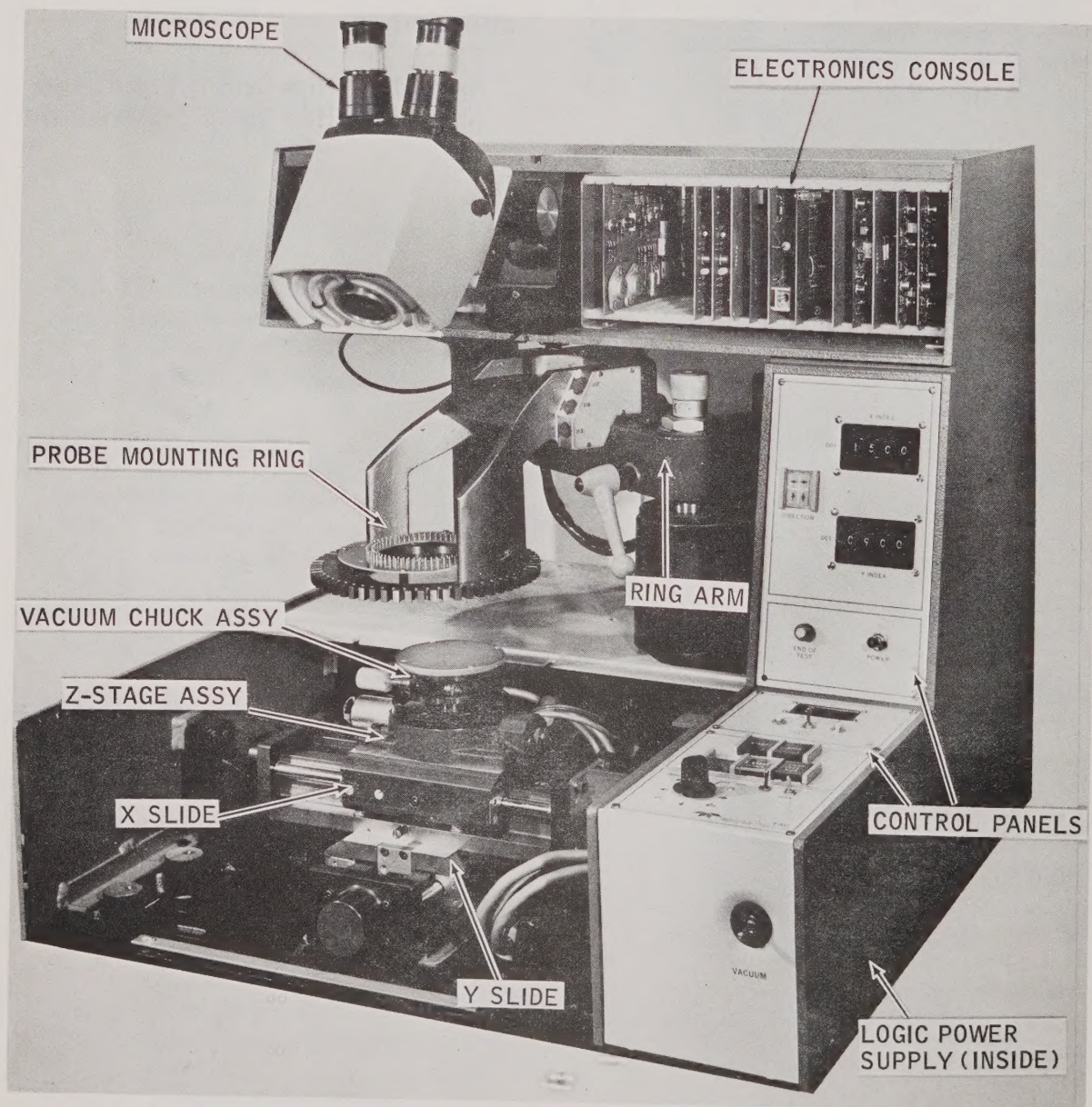
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SECTION 1

GENERAL INFORMATION

1-1 INTRODUCTION

This manual contains all the essential service and maintenance instructions required to service the standard TAC Model 1200 Semiconductor Slice Prober. The technician should become thoroughly familiar with the contents of this manual, especially Section 3 before attempting to service the machine. For machines that deviate substantially from the standard machine, a special addendum listing the differences is included at the end of this manual.

1-2 MACHINE OPERATION

The TAC Model 1200 Semiconductor Slice Prober is a production machine designed to automatically position the semiconductor slice to a set of probe heads for testing and classification purposes during the production process. It accommodates semiconductor slices up to three inches in diameter on a gold-plated vacuum chuck which is moved in precise increments in the X (left-right) and Y (in-out) directions and raised in the Z (up-down) direction to make contact with the probe heads.

Once the probe heads are aligned by the operator to the devices on the semiconductor slice, testing of the slice is performed automatically, row-by-row in a checkerboard pattern until the entire slice is tested. Direction change of the vacuum chuck is achieved by the edge-sensing probe or probes which determine when the edge of the slice has been reached and informs the machine to move to the next row of devices on the slice. The devices on the slice are

automatically marked by an Inker for classification purposes.

1-3 MACHINE COMPONENTS

The major components that make up the standard TAC Model 1200 Semiconductor Slice Prober are:

- a. Vacuum Chuck Assembly
- b. Z-Stage Assembly
- c. XY Table
- d. Probe Mounting Ring
- e. Ring Arm
- f. Microscope
- g. Control Panels
- h. Electronics Console
- i. Power Supplies

1-3.1 Vacuum Chuck Assembly

The vacuum chuck assembly holds the semiconductor slice in place by means of a vacuum through the hole pattern of its top surface, which is gold-plated and machined to an extremely flat surface. A knurled control knob on the side of the vacuum chuck is used to align the semiconductor slice in a rotary (θ) direction during the setup period.

1-3.2 Z-Stage Assembly

The Z-Stage assembly, located beneath the dust cover, mounts the vacuum chuck and

provides the up and down motion to make contact between the semiconductor slice and the probe heads during automatic testing. It may be raised and lowered manually by means of the Z-STAGE switch on the control panel.

The Z-Stage assembly consists of a base mount, tapered key, solenoid and a set of return springs. The tapered key is activated by the solenoid which pulls the Z-Stage down and compresses the return springs. When the solenoid is deenergized, the return springs decompress, lifting the Z-Stage up. A dash pot is connected to the tapered key on the opposite side of the solenoid. The dash pot is utilized to dampen the upward movement of the Z-Stage.

1-3.3 XY Table

The xy table, also located beneath the dust cover, supports the Z-Stage assembly and moves the semiconductor slice on the vacuum chuck in the x and y direction in response to command signals from the test equipment during the automatic mode of operation. During the manual mode, the table is moved in the x and y directions by means of a springloaded Joy stick conveniently located on the control panel.

The xy table consists of two precision ground table slides which provide x and y motion. The y slide mounts on the bottom of the machine base while the x slide mounts on the y slide. Each slide contains a stepping motor, lead screw, a flexible coupling and a pair of guide rails for precision parallel motion.

The stepping motor operates at a top speed of 2000 steps per second during the automatic mode and each step is equivalent to 1.8° of mechanical rotation, which is translated to 1.0 mil of horizontal travel when a 5-pitch lead screw is utilized.

1-3.4 Ring Arm

The ring arm, located above the vacuum chuck, holds the probe mounting ring with the probe heads. The ring arm is latched in the normal front position during the testing periods. It is rotated to the rear of the machine by means of the Ring Arm lock handle for loading and unloading of the semiconductor slice. Both the "normal and "loading" positions of the ring arm have a detent which latches the ring arm in place. The ring arm is raised and lowered for probe alignment by means of the Micrometer head located on the right side.

1-3.5 Probe Mounting Ring

The probe mounting ring, located directly over the vacuum chuck, holds the probe heads, edge-sensing probes and inkers. The probe mounting ring remains stationary as the vacuum chuck is moved in the X and Y direction and raised in the Z direction to make contact between the probes and the devices on the semiconductor slice. The number of probe heads on the mounting ring will vary depending on the number and type of devices on the semiconductor slice that are to be tested. The probe mounting ring can be easily removed so that probe patterns may be changed and setup outside the machine.

1-3.6 Microscope

The microscope, located above the probe mounting ring, is used during the setup period to align the slice on the vacuum chuck and to align the probes on the devices of the slice. It is adjustable from a fully vertical position to a 45 degree angle and it has a mercury vapor illuminator, which is automatically turned off during the automatic mode and turned on during the manual mode. An override switch is provided to turn the

illuminator on during the automatic mode. A sharp, single pointer is provided in the left eyepiece for alignment of the slice.

1-3.7 Control Panels

The controls and indicators required in the operation of this machine are conveniently located on the front right side. They are grouped according to their frequency of use thus allowing the operator to develop a "touch" technique and operate them without looking. The function of each control and indicator is described in Section 2 of this manual.

1-3.8 Electronics Console

The electronics console, located at the top-front of the machine, contains the printed circuit cards required to control the operation of the machine. Access to the cards is achieved simply by removing the console cover. Card extenders are provided to facilitate calibration and alignment of the circuits on the cards.

1-3.9 Power Supplies

There are two major power supplies in the machine: the Main Power Supply and the Logic Power Supply. The Main Power Supply consists of two transformers and a rectifier bridge which are located at the rear of the machine. Transformer T1 provides 17.8 vac (center tap) and 25 vac for the Logic Power Supply. Transformer T2 provides 60 vdc for the motor circuits.

The Logic Power Supply, located under the control panels, is a self-contained modular assembly consisting of the following circuits.

- a. + 28 VDC Regulator

- b. + 5 VDC Regulator

- c. $\pm$ 8V DC Supply

- d. Motor Drive Transistors

- e. Constant Current Generators

The dc supplies receive their inputs from the Main Power Supply and furnish dc power for the various logic circuits within the machine. The motor drive transistors provide the drive current for the x and y stepping motors in response to sequencing pulse from the motor logic. The constant current generators maintain a constant 60 vdc, 3 amp level for the stepping motors while they are driving. Detailed descriptions of each of the above circuits are presented in Section 3 of this manual.

1-4 SPECIFICATIONS

The pertinent specifications for the standard TAC Model 1200 Semiconductor Slice Prober are presented below:

Table Speed	up to 2 inches/ sec for 5-pitch machines up to 1 inches/ sec for 10-pitch machines
Table Accuracy	$+ 95 \times 10^{-6}$ inches/inch travel @ 68°F
Minimum Step	0.001 inch for 5-pitch machines 0.0005 inch for 10-pitch machines

Maximum Index	0.999 inch for 5-pitch machine 0.9995 inch for 10-pitch machine
Total X Travel	4 inches
Total Y Travel	4 inches
Z-Stage Travel	
Maximum Travel	0.015 inches
Travel Time	60 milliseconds (up) 30 milliseconds (down)
Power Requirements	115 vac, 5 amp. 60 Hz
Vacuum Requirements	20 inches
Net Weight	225 lbs.
Shipping Weight	350 lbs.
Height	24 inches
Width	24 inches
Depth	24 inches
Vacuum Chuck	
Diameter	3-1/4 inches
Hole Pattern	1-5/8 inches (std.) 7/8 inch (opt.)
Probe Mounting Ring	
Standard	24 position
Optional	60 position
Microscope	B & L stereo 10.5 to 45x
Probe Heads	As required
Edge-Sensing Probes	As required
Inkers	As required

SECTION 2

CONDENSED OPERATING INSTRUCTIONS

2-1 INTRODUCTION

This section of the manual contains condensed operating instructions for the manual jog, automatic and manual index modes of operation. For more detailed instructions, refer to the Installation and Operation manual. Also included in this section are the functional descriptions of the controls and indicators for the standard Model 1200 machine.

2-2 MANUAL JOG MODE

- a. Place the MAN/AUTO switch in the MAN position and the INDEX/JOG switch in the JOG position.
- b. Depress the POWER circuit breaker and wait approximately 10 seconds for the electronic circuits to stabilize.
- c. Depress the Z-STAGE switch to the DOWN position.
- d. Set the Speed switch to HI, MED or LO for the desired table speed.
- e. Deflect the Joy stick to move the XY table in the desired direction.
- c. Roughly align the probe heads.
- d. Planarize the probe heads.
- e. Perform the fine alignment of the probe heads.
- f. Perform the fine alignment of the edge-sensing probes.
- g. Perform the fine alignment of the inkers.
- h. Set the index and inker switches to their proper settings.
- i. Place the AUTO/MAN switch in the AUTO position.
- j. Depress the START switch.

NOTE

For semi-automatic operation, disconnect the cable to the computer and depress the STEP switch.

2-3 AUTOMATIC MODE

- a. Place the machine in the manual jog mode.
- b. Place a slice on the vacuum chuck and align it in the X axis with the Orientation $\oplus$ knob on the Vacuum chuck.

2-4 INDEX MODE

- a. Place the MAN/AUTO switch in the MAN position and rotate the INDEX/JOG switch to the INDEX position.
- b. Set the X INDEX and Y INDEX switches to the desired step length. Depress the Z-STAGE switch to the DOWN position.

- c. Momentarily depress the Joy stick in the desired direction. The xy table will move one index.
- d. For continuous indexing, hold the Joy stick depressed in the desired direction.

POWER, circuit breaker

Applies electrical power to the machine when depressed and removes power when pulled out.

2-5 CONTROLS AND INDICATORS

The controls and indicators for the standard 1200 machine are described on the following pages.

Control/Indicator

"X" INDEX, thumbwheel switches

Selects the distance the vacuum chuck will step in the x direction during the automatic and index modes. Step lengths are selected in thousandths of an inch (mils).

"Y" INDEX, thumbwheel switches

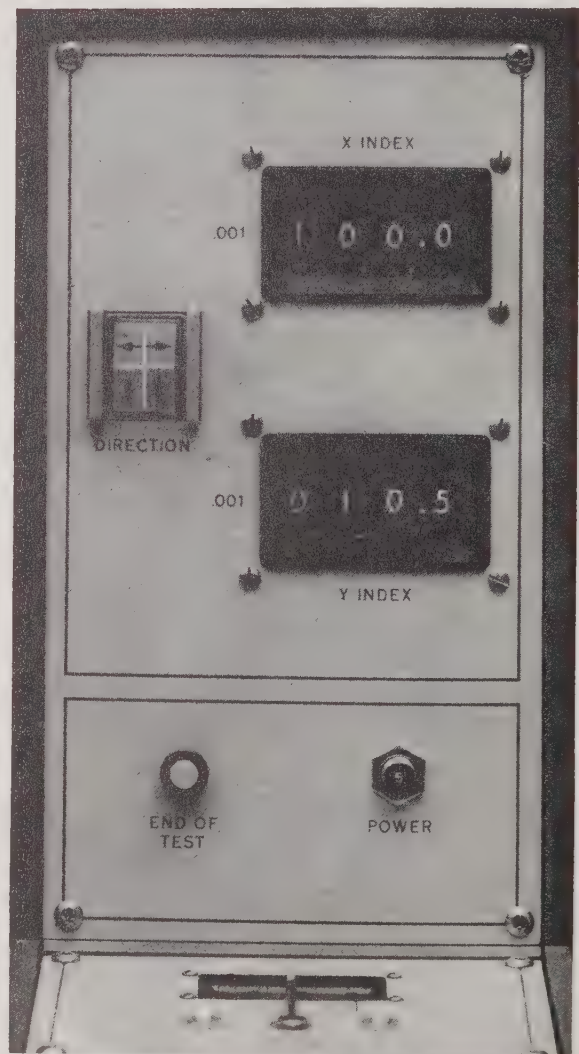
Selects the distance the vacuum chuck will step in the y direction during the automatic and index modes. Step lengths are selected in thousandths of an inch (mils).

DIRECTION, indicator

Illuminates to indicate the direction of vacuum chuck travel during all modes. In the automatic mode it will indicate the starting direction.

END OF TEST, indicator

Illuminates to indicate the entire slice has been tested and the vacuum chuck has reached a travel limit.



MEMORY INK (A,B), thumbwheel switches

Selects one of three inking modes for the marking of the devices.

"0" = in-place inking

"1" = one-step-behind inking

"2" = two-step-behind inking

MEMORY INK (test), thumbwheel switch

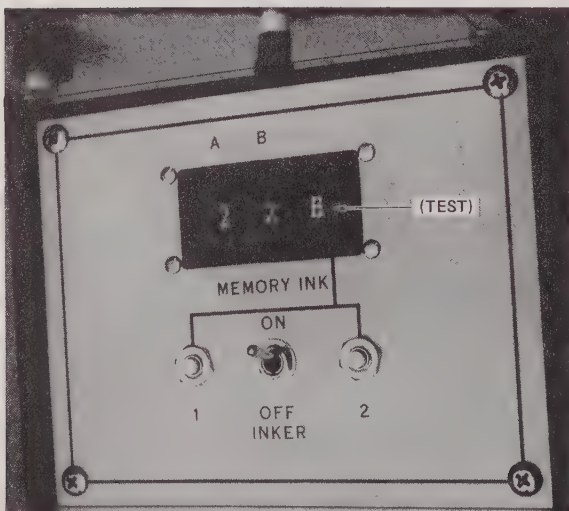
Selects one set of inkers at a time for manual testing during the setup period.

INKER (ON/OFF), toggle switch

Enables the inkers to operate when the switch is in the ON position.

INKER (1,2) pushbutton switches

Operates the inker when depressed if the INKER switch is in the ON position. Used with MEMORY INK (test) switch during the setup period.



START, pushbutton switch/light

Enables the machine to begin automatic testing when depressed and AUTO/MAN switch is in AUTO.

STOP, pushbutton switch/light

Stops the machine during the automatic mode when depressed. The machine will complete the "in-progress" step, but will not raise Z-stage to perform testing of the device.

STEP, pushbutton switch/light

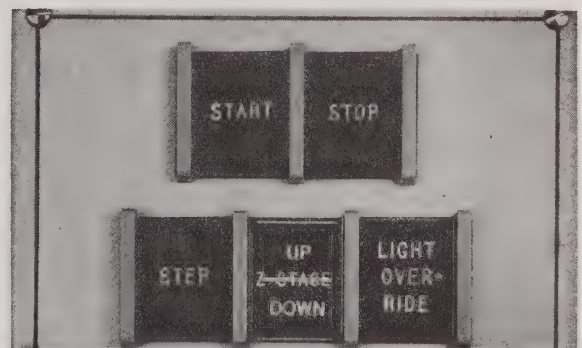
Used for semi-automatic operations. Enables the vacuum chuck to move one step when depressed if the AUTO/MAN switch is in AUTO, the START switch is on and the test equipment is not connected to the machine.

Z-STAGE, pushbutton switch/light

Enables the vacuum chuck to alternately raise and lower each time it is depressed.

LIGHT OVER-RIDE, pushbutton switch/light

Turns on the microscope light when depressed and the AUTO/MAN switch is in the AUTO position.



AUTO/MAN, toggle switch

Selects either the manual or automatic mode of operation.

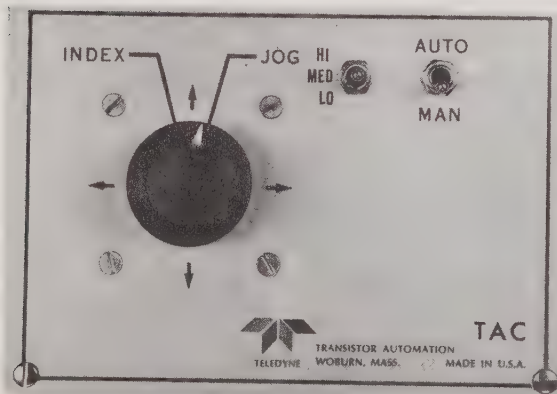
INDEX/JOG, rotary switch

Selects either the index or jog mode of operation when the AUTO/MAN switch is in the MAN position.

Speed, toggle switch

Selects one of three speeds for the XY table during the Manual Jog mode as follows:

HI	= up to 2000 pps
MED	= 100 pps
LO	= 5 pps



Joy Stick

Moves the XY table continuously in one of four directions when held deflected during the Manual Jog mode. The table stops when the Joy stick is released.

Moves the XY table one index in one of four directions when momentarily deflected during the Manual Index mode. The table indexes continu-

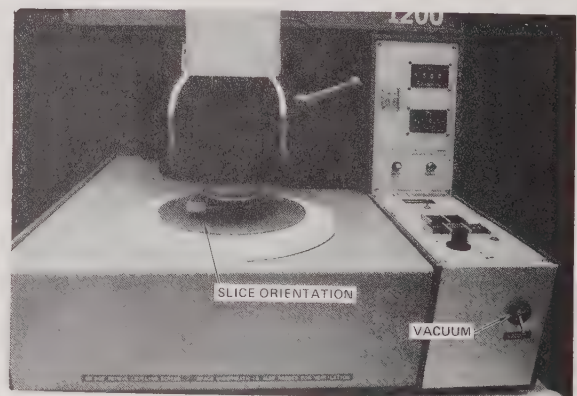
ously when the Joy stick is held deflected.

Vacuum, toggle switch

Applies a vacuum to the slice on the vacuum chuck when depressed in any direction.

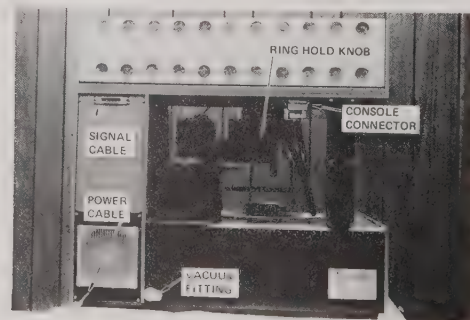
Slice Orientation, knob

Rotates the vacuum chuck in a rotary (θ) direction to align the slice with the probes.



Ring Hold, knob (rear of machine)

Tightens the holding clamp that secures the probe mounting ring to the ring arm assembly when rotated clockwise.



Micrometer, gauge (A)

Raises and lowers the probe mounting ring towards the vacuum chuck for probe alignment during the setup period; it is calibrated in thousandths of an inch (mils).

Ring Arm, lock handle (B)

Releases the ring arm assembly for backward movement to the "loading" position when raised. Locks assembly when depressed.

Edge-Sense, lamp (C)

Used with contact closure type probes during setup period. Lamp is out when probe is contacting the slice.

Microscope Lock, handle (D)

Releases the microscope for push/pull movement towards the operator when depressed to the left; locks microscope in place when depressed to the right.

Focus, knobs (E)

Adjusts the focus of the microscope by lowering and raising it towards the vacuum chuck.

Stereo-Zoom, knob (F)

Increases and decreases the magnification power of the microscope.

Reference Pointer, eyepiece (G)

Rotates the reference pointer in the eye-piece of the microscope for alignment.



SECTION 3

THEORY OF OPERATION

3-1 OVERALL SYSTEM DESCRIPTION

The Model 1200 Semiconductor Slice Prober has three major modes of operation, automatic, manual jog and manual index. An overall explanation of these three modes is presented below along with a functional block diagram, figure 3-1, showing the relationships between the printed circuit cards, relays and control panel switches that control the machine. A typical timing cycle is shown in figure 3-2.

3-1.1 Automatic Mode

When the switches on the control panels have been setup for the automatic mode of operation as outlined in the Installation & Operation manual, the machine is activated for automatic testing by means of the START pushbutton. When the START pushbutton is depressed, a ground pulse appears on the Z-STAGE INHIBIT line causing the Z-Stage Drive card to deenergize the Z-Stage solenoid. The Z-Stage card also removes the ground level on the START TEST ENABLE line which starts the timing in the Edge Sensor card. When the Z-Stage solenoid deenergizes, the Z-Stage raises to make contact between the probe heads and the semiconductor slice. If the edge sensing probes detect the slice, the Edge Sensor card produces a START TEST signal, which allows the customer's test equipment to begin testing the device on the slice.

The START TEST signal is produced 60-70 milliseconds after the START TEST ENABLE signal is issued in order to allow for the rise time of the Z-Stage. When the testing of the device is completed,

the customer's test equipment may or may not issue an INKER REJECT signal depending on the test results. If the INKER REJECT signal is issued, it activates the Inkers to mark the devices in-place, one-step-behind or two-steps-behind, depending on the setting of the inker switches on the Inker panel. After the INKER REJECT signal has been issued, the customer's test equipment issues an END OF TEST signal to the Z-Stage Drive card which lowers the Z-Stage. The Z-Stage Drive card produces a positive signal on the Z-STAGE SHIFT line which shifts the data in the Inker Control circuits for one-step or two-step-behind inking.

Approximately 35 milliseconds after receipt of the END OF TEST signal, the Z-Stage Drive card produces a negative pulse on the OSC START line which starts the oscillator in the Acc & Dec Gate card. Assuming the machine is reset for -X movement, the oscillator will produce pulses on the COUNT and REV COUNT lines which upcount the Counters and activate the Motor Driver card.

The Motor Drive card provides sequencing pulses for the X stepping motor which is enabled since the High Voltage Control card is providing a positive level on the X ENABLE line. The Main Power Supply furnishes 60 vdc to the windings of the X stepping motor via the Constant Current Generators which are utilized to ensure that the motor current does not exceed 1.5 amps per winding.

The Counters which consist of three 4-stage flip flops are interconnected with the digi-switches on the Index panel. When the

Counters reach 7 counts (6 counts for 10-pitch machines) from the preselected setting of the digiswitches, a ground signal appears on the OSC STOP line which activates the deceleration counter in the Acc & Dec Gate card to complete the remaining 7 (or 6) counts.

When the count is completed, a ground signal level appears on the COUNT COMPL line which is fed to the Lamp Driver. This produces a ground level on the OSC INHIB line which stops the oscillator in the Acc & Dec Gate card and inhibits the High Voltage Control card thus stopping the X stepping motor and turning off the high voltage. The ground level on the OSC INHIB line is also fed to the Z-Stage Driver card which causes the Z-Stage solenoid to deenergize. The Z-Stage card removes the ground level on the START TEST ENABLE line for the Edge sensor card and produces a negative level on the RESET EDGE SENSOR line which resets the sensor and relay flip-flops on the Edge Sensor card. The Z-Stage rises and if a slice is present, the Edge Sensor card issues a START TEST signal to the customer's test equipment. The START TEST signal is produced 60-70 milliseconds after the START TEST ENABLE signal. When the testing is completed the customer's test equipment will issue an INKER REJECT Signal, if required and then an END OF TEST signal to initiate another cycle.

The above indexing cycle will repeat until each device on the X axis row has been tested. When the edge sensing probe detects the edge of the slice, the Edge Sensor card produces an inhibit signal which prevents the generation of a START TEST signal for the customer's test equipment. Instead, the Edge Sensor card produces a positive pulse on the RESTART Z-STAGE line and a ground on the ENERGIZE Y line which

energizes the XY relays and primes the High Voltage Control card by placing a negative level on the HIGH VOLTAGE DIRECTION line. When the XY Relays energize, a ground pulse is applied to ENERGIZE REV RELAY line which sets the Reverse Relay flip flop thus energizing the Rev Relay. The Z-Stage Drive card energizes the Z-Stage solenoid and thus lowers the Z-Stage. Approximately 35 milliseconds after receipt of the Z-STAGE RESTART signal, the Z-Stage Drive card produces a negative pulse on the OSC START line.

The oscillator in the Acc & Dec Gate card turns on and produces pulses for the COUNT and REV COUNT lines; however, the pulse will be routed to the Y stepping motor since the XY relays are energized. Reverse direction is maintained since a ground level is held on the REVERSE line to the Acc & Dec Gate card via the XY relays switching. The output from the digiswitches is routed to the Acc & Dec Gate card via the XY relays. When the Y count is completed, the ground level appearing on the OSC INHIB line stops the oscillator in the Acc & Dec Gate card and inhibits the High Voltage Control thus stopping the Y stepping motor. The Z-Stage card now performs the following functions: (1) It deenergizes the Z-Stage solenoid to raise the vacuum check. (2) It issues a ground signal on the RESET EDGE SENSOR line which causes the Edge Sensor card to deenergize the XY relays and (3) It removes the ground level on the START TEST ENABLE which starts the timing in the Edge Sensor card. If the edge sensing probes detect a slice, the Edge-Sensor card will issue a START TEST signal to the customer's test equipment. If no slice is detected, a Z-STAGE RESTART signal will be generated.

Assuming that the slice is not present, the Edge Sensing card will issue a Z-STAGE

RESTART signal to the Z-Stage Drive card which will lower the Z-Stage. Approximately 35 milliseconds after receipt of the Z-STAGE RESTART signal, the Z-Stage Drive card produces a negative pulse on the OSC START line to activate the oscillator in the Acc & Dec Gate card and thus initiate the stepping and counting operations. The count pulses will be routed on the FWD COUNT line since the REVERSE line to the Acc & Dec Gate card is at a positive level. The XY relays are deenergized and the reverse relays are energized at this time. The machine will automatically index in the +X direction until it detects the first edge of the slice. At this point, the Edge Sensor will issue a START TEST signal for the customer's equipment and the machine will test every device in the row until it reaches the alternate edge of the slice. It will then take one index in Y and reverse itself in X. These forward and reverse cycles will continue until the machine has tested every device on every row of the slice. When the last device on the last row has been tested, the machine will change direction; however, since there are no more rows on the slice, the edge sensor will never make contact with the slice. The machine will step through the empty row and continue on until it reaches an X limit switch. This causes the Motor Driver card to stop the XY table and the End of Test lamp on the Index panel lights to inform the operator that the slice has been completely tested.

If the STOP switch is depressed, the machine will complete the in process index and stop, but will not raise the Z Stage. The START TEST signal will not be issued at this time since the START TEST ENABLE line is held at ground.

3-1.2 Manual Jog Mode

When the switches on the control panels have been setup for the Manual Jog mode as

directed in the Installation and Operation manual, jogging is initiated by means of the Joy stick. When the Joy stick is deflected in one of the four directions, it produces a negative pulse on the OSC START line which activates the oscillator in the Acc & Dec Gate card, thus producing the stepping pulses for the Motor Driver card. The digiswitches are deactivated during this mode. A three position Speed switch on the Control panel selects pulse rates of 5,100 or a top rate of 2000 pps for the stepping motors. When the Joy stick is released to its neutral position, it produces a ground level on the OSC STOP line which immediately stops the oscillator and the stepping motor. The deceleration circuit in the Acc & Dec Gate card is disabled during the Manual Jog mode, thus eliminating the 7 (or 6) downcount deceleration operation. Direction of the XY table is determined by the position of the Joy stick which energizes the XY and Reverse relays accordingly, (this is explained in paragraph 3-2.6).

3-1.3 Manual Index Mode

When the switches on the control panels are setup for the Index mode as outlined in the Installation and Operation manual, the indexing cycle is initiated by means of the Joy stick. When the Joy stick is deflected in one of four directions, it produces a negative pulse on the OSC START line which activates the oscillator in the Acc & Dec Gate card, thus producing the count and step pulses. The digiswitches are activated during the Index mode and the table will step in the direction of the Joy stick at the distance determined by the digiswitches. The deceleration circuit in the Acc & Dec gate card is activated during the Index mode and it will provide the final 7 (or 6) counts for the stepping motor. Direction of the XY table is controlled by the position of the Joy stick which energizes the XY and Reverse relays

accordingly. When the Joy stick is held deflected, the XY table indexes continuously with a slight pause between each index. When the Joy stick is momentarily deflected, the XY table will complete one index and stop.

3-2 FUNCTIONAL DESCRIPTIONS

For purposes of discussion, the operation of the standard Model 1200 machine may be considered as having eight major functions:

- a. Automatic mode start/stop
- b. Automatic mode direction control
- c. Automatic mode inker control
- d. Manual jog mode start/stop
- e. Manual index mode start/stop
- f. Manual mode direction control
- g. Manual Jog mode deceleration inhibit
- h. Manual Z-stage control

Each of these functions is described in the following paragraphs with reference to detailed block diagrams that show the complete loop for each function.

3-2.1 Automatic Mode Start/Stop (Figure 3-3)

In the Automatic mode the AUTO/MAN switch S28B is in the AUTO position. Z-STAGE switch S25C is in the Down position and STOP switch S23 is in the deactivated position. When the START switch S22 is depressed, ground is applied to the Start/Stop relay, allowing it to

energize. Contacts 2 and 3 of the Start/Stop relay close and latch the relay on. Contacts 5 and 4 of this relay close and provide a ground pulse to pin K of the Z-Stage Drive card via Component Board #2 and contacts B and A of the Index relay. The Z-stage card removes the ground at pin E which enables the Z-Stage solenoid to deenergize. Ground is also removed on the START TEST ENABLE line which starts the timing in the Edge Sensor card. A ground pulse appears on the RESET EDGE SENSOR line which resets the Edge Sensor card. If the edge sensing probe detects a slice, the Edge Sensor card issues a START TEST signal for the customer's test equipment. The START TEST signal is produced 60 to 70 milliseconds after the ground level is removed from the START TEST ENABLE line at pin P. When the test is completed, the customer's test equipment issues a positive signal on the END OF TEST line which causes the Z-Stage Drive card to apply a ground at pin E and lower the Z-Stage.

Approximately 35 milliseconds after the receipt of the END OF TEST signal the Z-Stage Drive card generates a negative pulse on the OSC START line which activates the oscillator in Acc & Dec Gate card. The oscillator produces pulses at a top rate of 2000 pps for the counters and the stepping motors. The counters are connected to the digiswitches. As long as the count is greater than 7 (or 6 for 10-pitch machine), a positive level is present on the OSC STOP line via the XY relay and the AUTO/MAN switch S28C. When the counters reach 7 counts (or 6) from the pre-selected digiswitch setting a ground level appears on the OSC STOP line. This enables the deceleration counter in the Acc & Dec Gate card to complete the remaining counts. When the count is completed, a ground level appears on the COUNT COMP

line causing the Lamp Driver card to place a ground on the OSC INHIBIT line which stops the oscillator in the Acc & Dec Gate card. The Acc & Dec Gate card produces a ground level on the Z-STAGE INHIBIT line which is applied to the Z-Stage Drive card via Component Board #1, contacts 21 and 20 of the Start/Stop relay and Component Board #2. This ground level causes the Z-Stage Drive card to deenergize the Z-Stage solenoid and raise the Z-Stage assembly. Ground is removed from the START TEST ENABLE line, which starts the timing in the Edge Sensor card for another START TEST signal.

The above cycle will continue for each device in the X row of the slice. When the edge of the slice is detected, the Edge Sensor card inhibits the generation of a START TEST signal for the customer's equipment. Instead, it produces a RESTART Z-STAGE signal. The XY table steps in the Y direction for one index and then reverses direction in the X axis: this is explained in detail in paragraph 3-2.2. The machine may be used in the semi-automatic mode by means of the manual STEP switch. When the switch is depressed it supplies a simulated END OF TEST signal to the Z-Stage Drive card. The machine will complete one index, raise the Z-Stage, supply a start test signal and stop.

3-2.2 Automatic Mode Direction Control (Figure 3-4)

The automatic mode direction control function operates as follows. Assuming the XY table is moving in -X direction, the table will continue to move in this direction until the edge sensing probe detects the edge of the slice. At this point a ground appears on Pin E of the Edge Sensor card which energizes the XY-1 and XY-2 relays. The START TEST signal from pin C is inhibited at this time. The Edge Sensor

card issues a RESTART Z-STAGE signal on pin M which simulates the customer's EOT signal and restarts the oscillator. The HIGH VOLTAGE DIRECTION line is ground at this time. Therefore, when the oscillator starts, it enables the Y ENABLE line to the Logic Power Supply. The XY relays are energized, therefore, the table will move in the -Y axis since a ground is applied to the DIRECTION line of pin W of the Acc & Dec Gate card by the AUTO/MAN switch S28B, the XY-1 relay contacts R & S, and Component Board #2.

Contacts 3 and 2 of the XY-2 relay close to route the Y count from the digiswitches to the OSC STOP line of the Acc & Dec Gate card. Contacts K and J of the XY-1 relay close to route the REV pulses to the -Y line. When a negative pulse appears at the OSC START line, the Acc & Dec Gate card provides reverse pulses on the -Y line which steps the Y motor in the negative direction. When the Y count is 7 (or 6) counts from the preselected Y digiswitch setting, a ground pulse appears on the OSC STOP line and the deceleration counter in the Acc & Dec Gate card completes the remaining counts to stop the oscillator.

Contacts 21 and 20 of the XY-2 relay close and set the flip flop in the .5 Counter card which energizes the Reverse relays via contacts E and F of the deenergized Index relay. This shifts the drive pulses of the Inker Drive card from Inker A1 to Inker A2.

When the Z-Stage rises, it resets the Edge Sensor card which deenergizes the XY-1 and XY-2 relays. The HIGH VOLTAGE DIRECTION line is at a positive level at this time, therefore, when the oscillator starts, it enables the X ENABLE line to the Logic Power Supply. Contacts R and P of the XY-1 relay close to remove the ground at pin W of the Acc & Dec Gate card and contacts M and 7 close to route the

FWD output of the Acc & Dec Gate card to the +X line.

When a negative pulse appears on the OSC START line, the oscillator in the Acc & Dec Gate card will produce pulses on the FWD line since pin W is not at a ground level. The machine will step in the +X direction. Contacts 1 and 2 of the XY-2 relay are closed; therefore, when the X count is 7 (or 6) counts from the preselected digiswitch setting, a ground level appears on the OSC STOP line which enables the deceleration counter in the Acc & Dec Gate card to complete the remaining counts.

The sensor flip flop in the Edge Sensor card does not set until the edge sensing probe detects the first edge of the slice while traveling in the +X direction. When the edge is detected, the flip flop is set. When this occurs the Edge Sensor card is primed to initiate a direction change when the alternate edge of the slice is reached. When the XY relays energize, the table changes to the -X direction. The flip flop in the 0.5 Counter and Reverse Relay Drive card is toggled to the reset condition thus de-energizing the reverse relays.

Whenever the XY table reaches an X limit switch, a ground level is applied to the Index Pulser card which produces a positive pulse to reset the flip flop in the 0.5 Counter and Reverse Relay Drive card. This deenergizes the reverse relays to ensure that the first movement of the table in the automatic mode will be in the -X direction.

3-2.3 Automatic Mode Inker Control Function (Figure 3-5)

The inker control circuits determine whether the inker will mark the device in place, one-step behind, or two-step behind in accordance with the setting of the Inker panel switches. The number of Inkers

utilized in the machine will vary depending on the testing requirements; however, their operations are identical; therefore, a single inker control circuit will be described.

The Inker Drive card consists of a two-stage shift register and a five-stage amplifier which drives Inker 1 or 2, depending on the reverse relay. When the machine is programmed for in-place inking, Inker switch S10B is in the "0" position and ties pin H to pin C of the Inker Drive card. This effectively passes the two-stage shift register within the Inker Drive card. Inker switch S10A is in the "0" position and it routes the INKER REJECT line from the customer's equipment to pin B of the Inker Drive card. When the customer's test equipment issues a positive pulse on the INKER REJECT line, the 5-stage drive circuit in the Inker Drive card turns on and produces a negative pulse at pin P for approximately 70 milliseconds which energizes the Inker. The Y Inker adapter is connected between Inker 1 and 2 when only one Inker is used.

When the machine is programmed for one-step-behind inking, switch S10B is in the "1" position and ties pin F to pin H of the Inker Drive card. This places the shift registers within the Inker Drive card in the loop. Switch 10A is in the "1" position and it routes the INKER REJECT line to pin B directly. When the customer's test equipment produces a positive pulse on the INKER REJECT line, it is stored in the first shift register of the Inker Drive card and no output is produced at pin P, thus the device is not marked at this time. When the Z-Stage lowers, the Z-Stage Drive card produces a positive pulse on the Z-STAGE SHIFT line which shifts the pulse in the first shift register stage to the second one. No output appears at pin P of the Inker Drive card since it is inhibited by a positive level on the Z-STAGE UNLOCK line at pin M when the Z-Stage is in the down position.

After the table moves to the next index, a ground level appears at pin M of the Inker Drive card when the Z-Stage begins to rise. This causes the Inker Drive card to produce a negative pulse at pin P for approximately 70 milliseconds which energizes one of the inkers depending on the condition of the reverse relay.

When the machine is programmed for 2-step-behind inking, switch S10A is in the "2" position thus routing the INKER REJECT line to the Shift Register card before going to the Inker Drive card. When the customer's test equipment produces the first positive pulse on the INKER REJECT line, it is stored in the Shift Register card. No output appears at pin P of the Inker Drive card. When the Z-Stage lowers, a positive pulse appears on the Z-STAGE SHIFT line which shifts the pulse stored in the Shift Register card into the first stage of the shift register in the Inker Drive card. The machine will move one index and raise the Z-Stage; however, no output will appear at pin P. When the Z-Stage lowers for the second time, the pulse in the first stage of the shift register will shift to the second stage. When the machine moves to its second index and raises the Z-stage, the ground level appears on the Z-STAGE UNLOCK line at pin M thus allowing the Inker Drive card to produce a negative pulse at pin P to energize Inker 1 or 2.

Manual testing of each inker is performed by switch S20 which activates Inker 1, and switch S18 which activates Inker 2. Switch S16 determines which dual inker drive circuit will be tested when more than one circuit is utilized in the machine. Switch S19 supplies positive voltage to all the inkers.

3-2.4 Manual Jog Mode Start/Stop (Figure 3-6)

During the Jog mode, the AUTO/MAN

switch is in the MAN position and the INDEX/JOG switch is in the JOG position. The Index Relay is energized in the MAN mode. When the Joy stick is deflected in any one of four directions, so that one of the Jog microswitches is made, the Start/Stop relay energizes and applies a ground pulse on the OSC START line at pin J of the Acc & Dec Gate card via contacts 5 and 4 of the Start/Stop relay, Component Board #2, contacts B and C of the Index relay and Component Board #1. This enables the Acc and Dec Gate card to produce pulses for the Motor Drive card at pin E or F depending on the position of the Joy stick. Manual direction control is described in paragraph 3-2.6. Table speed is determined by the Speed switch on the control panel. When the switch is in the LO position, the table moves at approximately 5 pps since pin L of the Acc & Dec Gate card is tied to ground through a 100 ohm resistor. When the switch is in the MED position, the table moves at approximately 100 pps due to the signal present at pin D of the gate. When the switch is in the HI position, the table moves at a top speed of 2000 pps since pin L is tied directly to +12V.

The STOP OSC line at pin H of the Acc & Dec Gate card is at a positive level as long as the Joy stick is depressed. When the Joy stick is released to its neutral position, a ground level appears on the STOP OSC line via contacts 11 and 12 of the INDEX/JOG switch which initiates a STOP OSC pulse immediately. Pin N of the Acc & Dec Gate card is tied to pins M and B via the AUTO/MAN switch, the INDEX/JOG switch, and Component Board #2. Therefore, when the STOP OSC pulse appears, pin N is switched to ground, causing pin M and pin B to also be grounded. The ground on pin M stops the oscillator directly, while the ground on pin B resets the deceleration counter.

The Z-Stage Drive card is reset by a ground level at pin K via contacts V and W of the Index relay. The Edge Sensor card is inhibited by a positive level at pin H via contacts Y and X of the Index relay. These contacts also apply a positive level to pin M of the Z-Stage card, thereby inhibiting the E.O.T. signal.

A ground level is applied to pin P of the Edge Sensor card by the AUTO/MAN switch S28B and Component Board #2 which inhibits the unijunction in the Edge Sensor card from producing a START TEST pulse.

3-2.5 Manual Index Mode Start/Stop (Figure 3-7)

In the Manual Index mode, the AUTO/MAN switch is in the MAN position, the INDEX/JOG switch is in the INDEX position, and the Index relay is energized. When the Joy stick is deflected in one of four directions, it removes the ground at pin S of Component Board #2 allowing the Start/Stop relay to energize. Contacts 4 and 5 of the relay apply a ground pulse on the START OSC line at pin J of the Acc & Dec Gate card via Component Board #2, contacts B and C of the energized Index relay and Component Board #1. This activates the oscillator in the Acc & Dec Gate card which produces pulses for the counter and the stepping motor. When the count is 7 (or 6) count from the preselected digiswitch setting, a ground pulse appears on the STOP OSC line at pin H. This causes the deceleration counter in the Acc & Dec Gate card to complete the remaining 7 (or 6) counts. When the count is complete, a ground level appears on the COUNT COMP line causing the Lamp Driver card to apply a ground level on the OSC INHIBIT line to stop the oscillator. Direction control is determined by the position of the Joy stick which is described in paragraph 3-2.6.

When the Joy stick is in its relaxed position, pin E of the Index Pulser card is held to ground. This inhibits the RESTART INDEX pulse from pin P of this card. If the Joy stick is held deflected, a START OSC pulse is initiated as stated above. When the oscillator is running, pin H is held high forcing pin N to ground, which inhibits the unijunction delay on the Index Pulser card. When the oscillator has finished its count, pin H is driven to ground, raising pin N. If the Joy stick is held deflected and the oscillator is stopped, pin U of the Index Pulser card is at a positive potential, allowing the unijunction delay to operate. When the unijunction fires, pin S raises and forces pin M to ground, this produces a negative pulse on pin P which is coupled to the START OSC line via contacts B & C of the Index relay and Component Board #1 to initiate another index cycle. Once the index cycle is started, pin U is driven to ground, thus inhibiting another START OSC pulse until the oscillator stops once again.

If the Joy stick is momentarily depressed and released, pin H is held high, forcing pin N to ground until the oscillator has finished its count. When pin N is forced to ground, it enables the holding contacts of the XY relays, and REV relays via Component Board #1. Therefore, once a direction is momentarily selected, the table will index in that direction until the oscillator has completed its count at which time it releases any relays which had been activated.

The Z-Stage Drive card is reset by a ground level at pin K via contacts V and W of the Index relay. The Edge Sensor card is inhibited by a positive level at pin H via contacts Y and X of the Index relay to prevent the Edge Sensor card from energizing the XY relays since they are energized by the Joy stick. Contacts X and Y of the

Index relay also apply a positive level to pin M of the Z-Stage card thereby inhibiting the E.O.T. signal. With the Z-Stage solenoid energized, pin P of the Edge Sensor card is held to ground, inhibiting the START TEST signal.

3-2.6 Manual Mode Direction Control (Figure 3-8)

When the Joy stick is deflected in the "up" (+y) direction, ground is applied to the XY relays via the diodes in Component Board #1 and Component Board #2 causing the relays to energize. The Joy stick also energizes the REV relay by means of the diode on Component Board #2, and starts the oscillator in the Acc & Dec Gate card by removing the ground from J9-19. The FWD line from pin E of the Acc & Dec Gate card is routed to the Y+ line via contacts M and H of XY-1 relay and Component Board #1. Pin W of the Acc & Dec Gate card is at a positive level since the reverse relay is energized. (This allows FWD pulses from the Acc & Dec Gate card to appear on the +Y line). The HIGH VOLTAGE DIRECTION line to the High Voltage Control card is at a ground level. This enables the Y line to the Main Power Supply thus allowing the stepping motor to step in the +Y direction.

The Motor Driver card provides the sequencing pulses for the stepping motor. When the Joy stick is deflected in the "down" (-Y) direction, the XY-2 and XY-1 relays energize. Ground is applied to pin W of the Acc & Dec Gate card, thus enabling pulses to appear on the REV line which are routed to the -Y line via contacts K and J of XY-1 relay and Component Board #1. The HIGH VOLTAGE DIRECTION line to the High Voltage Control card is at a ground level, thus enabling the Y line which allows the Y motor to step in the -Y direction.

When the Joy stick is depressed to the "left" (-x) direction, REV 1 relay is de-energized applying the ground at pin W of the Acc & Dec Gate card. This enables pulses to appear on the REV line which are routed to the -X line via contacts K and L of the deenergized XY-1 relay. The HIGH VOLTAGE DIRECTION line to the High Voltage Control card is at a positive level thus enabling the X line to drive the X motor in the -X direction.

When the Joy stick is depressed to the "right" (+x) direction, the REV-1 and REV-2 relays energize. The ground level is removed from pin W of the Acc & Dec Gate card thus causing the card to produce pulses on the FWD line which are routed to the +X line via contacts M and 7 of the deenergized XY-1 relay. The HIGH VOLTAGE DIRECTION line to the High Voltage Control card is at a positive level, thus enabling the X line which drives the X motor in the +X direction.

3-2.7 Manual Jog Mode Deceleration Inhibit Function (Figure 3-9)

The deceleration counter in the Acc & Dec Gate card is inhibited during the Manual Jog mode. When the Joy stick is released to its neutral position, a ground level appears on the OSC STOP line. This ground level toggles a flip flop in the Acc & Dec Gate card which drives pin N to ground. In the Manual Jog mode, pin N is connected to pins B and M by means of the AUTO/MAN switch S28A, the INDEX/JOG switch and the diodes on Component Board #2. Therefore, once a ground level appears at pin N, it applies a ground at pin M to inhibit the oscillator. Simultaneously, ground is applied to pin B which resets the deceleration counter. When the deceleration counter is reset, it applies ground at pin A, thus preventing the oscillator from

starting when the INDEX/JOG switch is first switched to the INDEX position.

3-2.8 Manual Z-Stage Control Function (Figure 3-10)

When the Z-Stage push button is depressed to the "up" position, contact S-25B opens to deenergize the Z-Stage solenoid. Contact S25A closes and applies ground to the STOP OSC and the OSC INH lines which prevent the oscillator in the Acc & Dec Gate card from producing pulses for the counter and the XY motors. When the STOP switch is depressed, the Start/Stop relay is deenergized and pins 5 and 6 of the relay apply a ground to pin E of the Z-Stage card. When the Z-Stage pushbutton is depressed to the "down" position, contact S25B closes and applies the ground level from pin E of the Z-Stage Drive card to the solenoid which energizes and lowers the Z-Stage assembly. Contact S25A opens, thus removing the ground from the OSC INH and STOP OSC line at the Acc & Dec Gate card which enables the oscillator to receive a START OSC pulse and begin pulsing.

With the Z-Stage switch in the UP position, the START switch and STOP switch are disabled.

3-3 PRINTED CIRCUIT CARD DESCRIPTIONS

The following paragraphs describe the operation of the printed circuit cards located in the electronics console and the four power supplies. The circuits are described on an individual basis; however, their relationship with other cards is explained when necessary in order to present the technician with an overall understanding of the function of the card. It is recommended that the technician familiarize himself with the functional descriptions presented in paragraph 3-2.1 through 3-2.8 for a better understanding of the inter-relationships between the cards.

3-3.1 Acc & Dec Gate Card 12768

The Acc & Dec Gate card produces: (1) forward and reverse pulses for the X and Y stepping motors, (2) count pulses for the Counter cards, and (3) deceleration counting for the Automatic and Index modes.

Operation of this card during the Automatic and Manual Index mode is as follows: Pin L is connected directly to +12 VDC. When a negative OSC START pulse appears at pin J, its negative-going leading edge turns off Q4. The positive output from the collector of Q4 sets the Inhibit flip flop Q6/Q7 by turning on Q6. The negative output from the collector of Q6 sets the deceleration counter Z3, Z4 and Z5 via CR15. This enables gate Z2 to produce a positive level on the COUNT COMPLETE line at pin A which is tied to the OSC INHIBIT line at pin M via the Lamp Driver card. Capacitor C3 is now allowed to charge.

The positive-going trailing edge of the OSC START pulse turns on Q7 via C8 & CR30 which produces a negative pulse to step the motor and upcount the counters. When Q7 turns off, the positive output from its

collector is coupled to the acceleration capacitor C2 via C7 and CR28. Diode CR29 is utilized to clip the negative spikes from Q7. The acceleration capacitor C2 charges and begins to turn on Q1. When Q1 begins to turn on, it causes C3 to charge at a faster rate. When C3 reaches the firing level of unijunction Q5, the unijunction fires again and turns on Q7 which produces another pulse for the stepping motor and the counters. When Q7 turns off, the positive output from its collector deposits another charge on C2 which causes Q1 to drive harder and enables C3 to charge more rapidly to the firing level of the unijunction.

The above cycle continues until the acceleration capacitor C2 is charged to approximately 12.7 volts. When the voltage reaches this value it is clamped there through CR4. Unijunction Q5 is now firing at its top rate of 2000 pps. This pulse rate is adjusted by R54.

Transistor Q2 drives both gates Z1-6 and Z1-8; however, only one gate is activated depending on the state of transistors Q8 and Q11. When a ground level appears at pin W, Q8 turns off and produces a positive level at its collector which enables gate Z1-6 to produce pulses on the REVERSE COUNT line at pin F. When ground is removed from pin W, transistor Q11 turns off and a positive pulse level appears at its collector which enables gate Z1-8 to produce pulses on the FORWARD COUNT line at pin E. Pulses to Z10 have no effect at this time since it is held on due to the positive output from the collector of Q9.

Transistor Q3 is conducting during the counting operation. When the count card has reached 7 counts (or 6 counts) from the preselected digiswitch setting, a ground level appears on the OSC STOP line at pin H which cuts off Q3. The positive output

from the collector of Q3 resets the inhibit flip flop by turning on Q9 and turning off Q6. The negative level from the collector of Q9 is applied to the DEACC line at pin N, thus allowing capacitor C2 to begin discharging and causing Q1 to begin turning off. The discharge rate of the capacitor is adjusted by R19. Transistor Q10 is now released and the output from Q7 pulses Q10 which in turn pulses the deceleration counter Z3, Z4 and Z5. When the counter reaches 7 (or 6) gate Z2 produces a ground level at pin A which is externally connected to pin M via the Lamp Driver card thus stopping unijunction Q5 completely. When the gnd is applied to the inhibit line, it is coupled through CR1 & CR2 to reset the Z-Stage and counters respectively.

In the Manual Jog mode the deceleration counter Z3, Z4 and Z5 is not used. Pin N is externally connected to Pins M and B through diodes. When the Joy stick is deflected, it energizes the Start Stop relay and produces a negative pulse on the OSC START line at pin J. Transistor Q4 turns off and sets flip flop Q6/Q9 which removes the ground from the DEACC line at pin N, thus allowing capacitor C3 to begin charging and firing unijunction Q5. The pulse rate of the unijunction is determined by the Speed switch on the Control panel. When the Speed switch is in the LO position, the OSC SPEED line at pin L is externally connected to ground via a 100 ohm resistor, thus inhibiting Q1 and causing C3 to charge through pin D. This causes Q5 to pulse at a rate of approximately 5 pps. When the Speed switch is in the MED position, pin L is still connected to gnd through a 100 ohm resistor, thus inhibiting Q1 and causing C3 to charge through pin D. Q5 fires at a rate of approximately 100 pps. When the Speed switch is in the HI position pin L is tied to +12V, thus allowing Q1 to operate and Q5 fires at a top rate of 2000 pps.

The HI position is identical to the Automatic and Index positions for acceleration purposes.

When the Joy stick is released a ground level appears at the OSC STOP line at pin H which turns off Q3 and the positive output from its collector resets inhibit flip flop Q6/Q9 which applies a ground level on the DEACC line at pin N. This stops the unijunction immediately since pin N is connected to pin M through a diode on component Bd #2. The ground level on the DEACC line resets the deceleration counter since pin N is also connected to pin B through a diode on Component Bd #2. This produces a ground at pin A. Thus the deceleration counter is in effect inhibited during the Manual Jog mode.

Direction control during the Manual Jog mode is similar to that of the Automatic mode, the transistors Q8 and Q11 are turned on and off by the presence and absence of a ground level at pin W to produce the reverse or forward pulses at pins F and E, respectively.

3-3.2 Inker Drive Card 12769

The Inker Drive card consists of two flip flops, used as a shift register, and a 5-stage drive circuit to drive the inkers. When in-place inking is utilized, pin C is connected to pin H. When a positive signal from the test computer appears on the CUS-TOMER REJECT line at pin B, it is coupled to Q7 via pins C and H thus turning on Q7. When Q7 turns on, Q4 turns off and Q1/Q2 turn on to produce a negative INK output pulse at pin P. When Q2 saturates, a negative pulse is transmitted back to the base of Q4 via capacitor C5 holding Q4 off for approximately 70 milliseconds thus allowing transistor Q1 to remain on for this period which is sufficient to drive the inkers.

When one-step-behind inking is performed, pin F is connected to pin H. When a positive pulse appears on the CUSTOMER REJECT line at pin B, it turns on transistor Q3 of flip flop Q3/Q5. Flip flop Q6/Q9 is in the reset condition with Q6 off and the positive output from the collector of Q6 holds transistor Q8 on thus inhibiting any INK pulses at pin P. When the Z-Stage lowers, a positive Z-Stage Shift pulse appears at pin D which turns on Q5 of flip flop Q3/Q5 and the positive output of the collector of Q3 is coupled to Q6/Q9 causing Q6 to turn on. The negative output from the collector of Q6 has no effect on transistor Q8 at this time since the Z-Stage is down and pin M is held at a positive level. When the Z-Stage rises, a ground Z-Stage Unlock pulse appears at pin M which causes Q8 to turn off momentarily. The positive pulse from the collector of Q8 is coupled to the base of Q7 via connected pins F and H which turns on Q7, thus producing a pulse at pin P via Q4, Q2 and Q1 similar to that described above for in-place inking. When the Z-Stage lowers, it produces a positive Z-Stage Shift pulse at pin D which resets flip flop Q6/Q9, thus turning off Q6 which holds Q8 on and the circuit is ready for another one-step-behind inking cycle.

3-3.3 Motor Drive Card 12770

The Motor Driver card provides sequential drive pulses for the X and Y stepping motors. It contains 2 identical circuits, one for the X stepping motor and the other for the Y stepping motor; therefore, only the X circuit will be discussed.

When flip flop Z9 and Z10 are both in the set condition, a high level appears at Pin 6 and a low level at pin 9 of each flip flop. Transistors Q6 and Q8 are driving and transistors Q5 and Q7 are cut off. The inputs at pin 13 of gate Z7A and pin 10 of

gate Z7B are both low, thus providing high inputs to gate Z7C. The low output from the gate Z7C disables gate Z8B and Z8C while the high output from gate Z7D primes gates Z8A, and Z8D. When a negative (low) +X OSC pulse from the Acc & Dec card appears at pin K of gate Z3C for + direction, a high level appears at input gate Z8A which activates and produces a high input for flip flop Z9 via Z4C. When the negative pulse at Z3C terminates, the output of Z4C returns to a ground level which triggers Z9. Flip flop Z9 resets causing Q5 to turn on and Q6 to turn off.

When flip flop Z9 is in the reset condition and flip flop Z10 is in the set condition, both inputs to gate Z7B are high, thus producing a high level at the output of gate Z7C and a low level at the output of gate Z7D. Gates Z8A and Z8D are now disabled and gates Z8B and Z8C are primed. When a negative pulse appears at the input of gate Z3C, it activates gate Z8C which provides a high input to flip flop Z10 via gate Z4D. When the negative pulse at Z3C terminates, the output of Z4D returns to a low level which resets flip flop Z10 causing Q7 to turn on and Q8 to turn off.

Flip-flops Z9 and Z10 will alternately change states. One flip flop will switch for each +XOSC pulse which appears at gate Z3C, thus driving the 4 transistors Q5 thru Q8 in a sequential manner. Two transistors will always be driving at any one time.

When -X motion is desired, negative-XOSC pulses appear at pin L of gate Z3D and the sequencing of the transistors will be opposite of that for +X motion. For example, if both flip flops are in the initial set condition, flip flop Z10 would be reset first via gate Z4D and Z8D. Also, if Z-10 was toggled by the last +XOSC pulse in the

+X direction it will be toggled again by the first -XOSC pulse in the -X direction.

Whenever the XY table reaches the +X limit switch, a low level appears at pin 6 which inhibits gate Z3C. When the -X limit switch is reached, a low level appears at pin 7 which inhibits gate Z3D.

3-3.4 Edge Sensor Card (Strain Gauge Type) 12771

The Edge Sensor card performs the following function in the AUTOMATIC mode: (1) it amplifies and shapes the input signal from the edge sensor probes, (2) it issues a START TEST signal to the customer's test equipment, (3) it energizes the XY relays for direction changes, and (4) it restarts the index cycle when the edge of the slice is reached. When the Z-Stage is raised, a ground level from the Z-Stage Drive card appears on the RESET EDGE SENSOR line at pin Y which cuts off Q8. The positive pulse from the collector of Q8 resets the Sensor flip flop Q6/Q7 by turning on Q7. This same positive pulse resets The Relay Drive flip flop Q9/Q10 by turning on Q9. If the edge sensing probe detects the slice, a signal appears on the SENSOR line at pin U which is amplified and shaped by Q1 thru Q5 to produce a negative pulse at the collector of Q5 which sets the Sensor flip flop Q6/Q7 by turning off Q7. The positive output from the collector of Q7 sets the Intermediate flip flop Q11/Q12 by turning on Q11 which turns off Q12, producing a positive level at pin F. The unijunction Q13 is normally held off; however, when the Z-Stage is raised, the ground level from the Z-Stage Drive card is removed from the START TEST ENABLE line at pin P and the emitter capacitor C9 is allowed to charge. After approximately 60 to 70 milliseconds, Q13 fires to produce a START TEST signal at pin C for the test computer.

The above operation will continue each time the Z-Stage is raised and the slice is detected by the edge sensing probe. If the edge sensing probe does not detect the slice when the Z-Stage is raised, the Sensor flip flop Q6/Q7 will remain in the reset condition with Q7 on. This produces a ground level at pin C which inhibits the START TEST signal. When unijunction Q13 fires, it resets the Intermediate flip flop Q11/Q12 by turning on Q12. The positive pulse from the collector of Q11 sets the Relay Drive flip flop Q9/Q10. This applies a ground level on the ENERGIZE Y line at pin E which energizes the XY relays for a direction change. The positive pulse from unijunction Q13 also appears on the RESTART Z-STAGE line at pin M where it is utilized to initiate the next index cycle.

When the Z-Stage rises on the next cycle, the positive pulse from the collector of Q8 will reset the Relay Drive flip flop Q9/Q10 by turning on Q9 to remove the ground on the ENERGIZE Y line at pin E, which de-energizes the XY relays. If the edge sensing probe does not detect the slice, Sensor flip flop Q6/Q7 remains in the reset condition with Q7 on. The Intermediate flip flop remains in the reset condition with Q11 off; therefore, it has no effect on the Relay Drive flip flop. When the unijunction Q13 fires, a positive pulse appears at pin M for the RESTART Z-STAGE signal. No START TEST signal is produced for the customer's test equipment, since pin C is held at ground when Q7 is on.

This action continues until the first edge of the slice is detected. At this point, transistor Q5 produces a negative pulse which sets the Sensor flip flop by turning off Q7. The positive output from the collector of Q7 sets the Intermediate flip flop by turning on Q11. When unijunction Q13 fires, it will now produce a START TEST

signal for the customer's equipment. The Intermediate flip flop Q11/Q12 is now set; therefore, when the alternate edge of the slice is reached it will set the Relay Drive flip flop and thus energize the XY relays for another cycle.

When the optional 10-step Notch Hopper card is used, the Sensor flip flop Q6/Q7 and the Intermediate flip flop Q11/Q12 are interconnected to the Notch Hopper card such that the Intermediate flip flop is not allowed to set until the Z-Stage has made 10 movements once the edge of the slice has been detected and the machine has reversed directions. This allows the machine to continue in the reverse direction for 10 steps after it has reached the edge of the slice. The machine will not reverse directions until it has completed 10 steps regardless of whether it contacts the slice again within the 10 steps. A variable Notch Hopper card permitting a 5 to 30 step delay is also available.

3-3.5 Lamp Driver Card 12773

The Lamp Driver card consists of five NAND gates wired as shown in figure 3-11. When the machine completes the count, a ground level from the Acc & Dec Gate card appears on the COUNT COMPL line. Gate Q2 turns off and Q1 turns on to produce a ground level on the OSC INH line which inhibits the oscillator in the Acc & Dec Gate card. Gate Q4 turns off to prime gate Q3 with a positive level. When the Start Stop relay is deenergized it places a ground level on the STOP line. Gate Q5 turns off and gate Q3 turns on to maintain a ground level on the OSC INH line.

The OSC INH line will remain at a ground level until both the COUNT COMP and the STOP lines return to a positive level.

3-3.6 High Voltage Control Card 12773A

The High Voltage Control Card consists of five NAND gates which are interconnected to provide enabling levels for the X and Y stepping motors. Only one motor is enabled at any one time. A simplified logic diagram is presented in Figure 3-12.

The HIGH VOLTAGE DIRECTION line is controlled by the XY-2 relay. When a positive level is present on the HIGH VOLTAGE DIRECTION line (X direction), Q4 is primed to receive an OSC INHIBIT signal on pin V. Q5 is turned on at this time which turns Q3 off and Q1 on, thus disabling the Y ENABLE line.

When the OSC INHIBIT line goes positive, signifying the oscillator has been released, Q4 turns on, turning Q2 off enabling the X ENABLE line. When a ground level is present at the High Voltage Direction Line (Y direction) Q4 is turned off and Q2 on disabling the X ENABLE line. Q5 is turned off at this time priming Q3 for an OSC INHIBIT signal. When the OSC INHIBIT signal goes positive, Q3 turns on, turning Q1 off enabling the Y ENABLE line.

3-3.7 0.5 Counter and Reverse Relay Drive Card 12774

The 0.5 Counter and Reverse Relay Drive card provides two major functions in the Model 1200 Slice Prober. First, it divides the count from the oscillator in the Acc & Dec Gate card by 2 for use with a 10-pitch machine. Second, it drives the reverse relays in response to commands from the Edge Sensor card which controls the XY relays during the automatic mode.

Two independently operated flip flops comprise the card and perform the two functions mentioned above. The 0.5 Counter flip flop Q1/Q2 which divides the count pulses is toggled at Pin H by negative COUNT pulses from the Acc & Dec Gate card, and it is reset by a negative COUNTER RESET pulse at pin K which turns off Q2, thus producing a positive output level at pin E. Transistor Q1 is turned on, thus producing a negative level at pin M. Assuming the flip flop is in the reset condition, a negative pulse appearing at pin H will toggle the flip flop to the set condition, turning on Q2 which produces a negative output at pin E. Transistor Q1 turns off, thus producing a positive level at pin M. When the next negative pulse appears at pin H, the flip flop will toggle back to the reset condition. This toggling action will continue each time a negative pulse appears at pin H, thus producing the divide-by-2 count for 10-pitch machines. Reverse Relay Drive flip flop Q3/Q4 is reset at pin P by a positive RESET PROBER pulse from the Index Pulser card, which turns on Q4 and turns off Q3, thus removing the ground level at pin A and deenergizing the Reverse relays. This flip flop is toggled at pin C by negative REVERSE DIRECTION pulses from contacts V & U of the Index relay and contacts 21 and 20 of the XY-2 relay. Assuming the flip flop is in the reset condition, a negative pulse appearing at pin C will turn Q4 off and Q3 on, thus producing a ground level at pin A which energizes the Reverse relays. The next negative pulse appearing at pin C will toggle the flip flop back to the reset condition. This toggling action will continue each time a negative pulse appears at pin C.

3-3.8 +5.5V Power Supply Regulator 12776

The Power Supply Regulator contains a +5.5 vdc regulator and a -3 vdc regulator.

a. +5.5V Regulator

The +5.5V Regulator consists of Q1, Q2, Q3 and Q4. When power is applied to the circuit, Q1 and Q2 turn on to produce a +5.5 vdc output at pin R. If the output voltage drops below +5.5 vdc, the voltage at the base of Q3 drops and causes Q3 to conduct less. This increases the drive to Q2 and Q1, allowing them to drive harder and maintain the +5.5 vdc level. If the output voltage rises, the voltage at the base of Q3 rises and causes Q3 to conduct more. This reduces the drive to Q2 and Q1 causing them to drive less and thus maintain the +5.5 vdc level. Potentiometer R6 adjusts the output of the +5.5 vdc level. Transistor Q4 is used as a reference amplifier, with a constant voltage at its base thereby using its emitter as a reference.

b. -3V Regulator

The -3V Regulator consists of Q5, Q6, Q7 and Q8, and receives its input from the +5.5V Regulator and the -8 vdc supply in the Logic Power Supply card. If the output drops below the -3 volt level (for example, -4 vdc) transistor Q8, begins conducting more. This reduces the drive to Q5 and Q6 which conduct less and returns the output to the -3 vdc level. If the output level rises (for example, -2 vdc), transistor Q8 begins to turn off. This increases the drive to Q5 and Q6 which conduct more and return the output to the -3 vdc

level. Transistor Q7 is used as a reference amplifier. Potentiometer R20 adjusts the output level.

3-3.9 Two-Stage Shift Register Card 12777

The Two-Stage Shift Register card is used to provide 2-step-behind inking for the machine. Each stage operates independently; therefore, one card is used with two Inker Drive cards. Operation of the two stages is identical; therefore, only one will be described. Pin S is tied to pin A while pin C is tied to pin P.

When a positive INKER REJECT pulse appears at pin H from the test computer, flip flop Q2/Q3 sets. Transistor Q3 turns on and Q2 turns off. Since pin S is tied to pin A, the positive output from the collector of Q2 turns on Q6 which produces a ground level at pin Z. The INKER REJECT pulse appears when the Z-Stage is up. When the Z-Stage lowers, the Z-Stage Drive card removes the ground level on the Z-STAGE SHIFT line at pin F. This produces a positive pulse at the base of Q2 via C4 and CR3 which causes the flip flop Q2/Q3 to reset. Transistor Q2 turns on and the negative output from its collector turns off Q6 which in turn produces a positive level at pin Z for the ink signal to the Inker Driver card. Flip flop Q2/Q3 remains in the reset condition until another INKER REJECT pulse appears at pin H.

3-3.10 +12 VDC Power Supply Regulator 12778

The Power Supply Regulator contains a +12 vdc regulator and a -3 vdc regulator.

a. +12 VDC Regulator

The +12 VDC Regulator consists of Q1, Q2, Q3, and Q4. When power is applied to the circuit, Q1 and Q2 turn on to produce a +12 vdc output at pin X. If the output voltage drops below +12 vdc, the voltage at the base of Q3 falls and Q3 conducts less. This increases the drive to Q2 and Q1 allowing them to drive harder and maintain the +12 vdc level. If the output voltage rises, the voltage at the base of Q3 rises, and Q3 conducts more. This reduces the drive to Q2 and Q1 causing them to drive less and thus maintain the +12 vdc level. Potentiometer R10 adjusts the output of the +12 vdc level. Q4 is used as a reference amplifier.

b. -3 VDC Regulator

The -3 VDC Regulator consists of Q9, Q10, Q7, and Q8, and receives its input from the +12 VDC Regulator and the -8 vdc Power Supply in the Logic Power Supply card. If the output drops below the -3 volt level (for example -4 vdc) transistor Q8, begins to turn on harder. This reduces the drive to Q9 and Q10 causing them to conduct less and returns the output to the -3 vdc level. If the output level rises (for example, -2 vdc) transistor Q8 begins to turn off harder. This increases the drive to Q9 and Q10 causing them to conduct more and return the output

to the -3 vdc level. Potentiometer R19 adjusts the output level. Q7 is used as a reference amplifier.

3-3.11 Counter Board No. 1 Card 12779

The Counter Board No. 1 Card consists of two 4-stage flip flops which provide counting for the 1200 machine. The two stages are identical; however, only one stage is utilized to provide the hundreds counting for the machine. When a ground level from the Acc & Dec card appears on the COUNTER RESET line at pin A, transistor Q25 turns on and resets each flip flop stage by turning on transistors Q3, Q6, Q9 and Q12. This places a positive level at pins C, D, E and H which represent decimal 0. When the first negative COUNT pulse from Counter #2 or Counter #3 appears at pin F, transistor Q1 turns off and sets flip flop Q2/Q3 by turning on Q2. This places a ground level at pin H which represents decimal 100. When the second negative count pulse appears at pin F, transistor Q1 turns off and resets flip flop Q2/Q3 by turning off Q2. As transistor Q3 turns on, the negative pulse from its collector is coupled to the base of Q4. Transistor Q4 turns off and sets flip flop Q5/Q6 by turning on Q5. This places a positive level at pin H and a ground level at pin E which represents decimal 200. When the third negative count appears at pin F, flip flop Q2/Q3 will change to the set condition and flip flop Q5/Q6 will remain in the set condition. This produces a ground level at pin H and E which represents decimal 300. The flip flops will continue to operate in this manner for each pulse received at pin F thus allowing count pulses to shift through each stage of the 4-stage flip flop. Each flip flop changes state when the previous stage changes from the set to the reset condition.

Feedback is provided from the 4th stage flip flop Q11/Q12 to the 2nd stage flip flop Q5/Q6 thus producing the decimal counting.

At the end of the 8th count pulse, flip flop Q11/Q12 is set with Q11 conducting and producing a negative output at pin C which represents decimal 800. When the 9th count pulse appears at pin F, flip flop Q2/Q3 sets with Q2 turning on. This produces a ground at pin H and at pin C which represents decimal 900. When the 10th count pulse appears at pin F, flip flop Q2/Q3 resets and Q3 turns on. The negative pulse from the collector of Q3 has no effect on Q4 since the base of Q4 is held at a positive level from the output of Q12. The negative pulse from the collector of Q3 is, however, fed via capacitor C5 to the base of Q11 which resets flip flop Q11/Q12, thus producing positive levels at pins H, E, D & C which represent decimal 000.

The "hundreds" outputs from pins H, E, D & C are tied to the inputs of the digiswitches along with "tens" and "units" outputs of Counter Board No. 2 or Counter Board No. 3. When the counter outputs equal the digiswitches setting, the digiswitches produces an OSC STOP signal for the Acc & Dec Gate card.

3-3.12 Counter Board No. 2 Card 12779-A

Counter Board No. 2 card is identical to Counter Board No. 1 except that the first 4-stage flip flop is wired such that it resets to 7 whenever a pulse appears on the COUNTER RESET line at pin A. This board is used with 5-pitch machines and controls the units and tens count.

3-3.13 Counter Board No. 3 Card 12779-B

Counter Board No. 3 is used on 10-pitch machines and controls the units and tens count. Its operation is identical to that of Counter Board No. 1, except that it resets to 6 whenever a pulse appears on the reset line at pin A.

3-3.14 Z-Stage Drive Card 12782

The Z-Stage Drive card performs the following functions for the machine:

1. It raises the Z-Stage at the end of the counting and stepping operation.
2. When the Z-Stage rises, it starts the timing in the Edge Sensor card, and develops a ground level at pins C and H to activate the inker circuitry and reset the Edge Sensor card.
3. It lowers the Z-Stage upon receipt of an END OF TEST signal from the test computer.
4. It develops a positive level at pins C and H to shift the data in the Inker Control circuits when the Z-Stage lowers.
5. It issues an OSC START pulse for the Acc & Dec Gate card approximately 35 milliseconds after receipt of the END OF TEST signal to start another index cycle.

The Z-Stage card consists of a one shot Q1/Q2, a flip flop Q3/Q4 and a driver Q5. The flip flop is formed by externally connecting pins C and H. When the counting and stepping operation is completed, a

ground pulse appears at pin K and resets flip flop Q3/Q4 by turning off Q3. The output from the collector of Q4 drives towards ground which resets the Edge Sensor card and turns off Q5. This removes the ground on the SOLENOID line at pin E which starts the timing in the Edge Sensor card and deenergizes the Z-Stage solenoid to raise the Z-Stage. The Z-STAGE UNLOCK line at pins C and H goes to ground which activates the inker circuitry.

When an END OF TEST positive pulse appears at pin M from the test computer, it sets flip flop Q3/Q4 by turning on Q3. This turns on Q5, thus producing a ground level on the SOLENOID line at pin E which energizes the Z-Stage solenoid and lowers the Z-Stage. Ground is removed at pins C and H which shifts the data in the Inker Control circuits.

When transistor Q4 turns off, the positive output from its collector is coupled to the base of Q1 via C5. Transistor Q1 turns on and cuts off Q2 for approximately 35 milliseconds as determined by R1. At the end of this period, Q1 turns off and Q2 turns on, thus producing a negative pulse on the OSC START line at pin P which starts the oscillator in the Acc & Dec Gate card for another indexing cycle.

3-3.15 Index Pulser 12784

The Index Pulser card performs three functions. It produces RESTART INDEX pulses continuously for the Acc & Dec Gate card when the Joy stick is held deflected during the Manual Index mode. It enables the machine to complete an index when the Joy stick is momentarily deflected. It also produces RESET PROBER pulses to reset the machine whenever the table hits either one of the X limit switches. A simplified logic diagram is shown in figure 3-13.

When the Joy stick is in its neutral position during the Manual Index mode, the JOG INHIBIT line is at a ground level which prevents unijunction delay Q4/Q5 from firing. When the Joy stick is deflected, the oscillator in the Acc & Dec Card is activated to start the first index. When the oscillator is running, the OSC INHIB line is at a positive level which turns on Q3 to produce a ground level on the OSC STOP line which inhibits unijunction delay Q4/Q5 at pin U. When the oscillator finishes its count, the OSC INHIB line goes to ground and turns off Q3 which produces a positive level at pin N.

If the Joy stick is still deflected, the JOG INHIBIT line is at a positive level when pin N goes positive. This enables unijunction delay Q3/Q4 to fire after a short delay and produce a positive pulse at pin S. Transistor Q2 turns on and produces a negative pulse on the RESTART INDEX line which triggers the oscillator in the Acc & Dec Gate card for another index cycle. These cycles will continue as long as the Joy stick is held deflected.

Whenever the XY table hits an X limit switch, a ground level appears at pin A or B and turns off Q1. This produces a positive level on the RESET PROBER line which resets the reverse relay flip flop in the 0.5 Counter card.

During the Automatic mode, the unijunction delay is inhibited by a ground level from contacts U and V of the deenergized Index relay.

Once the Joy stick is deflected, pin H goes to a positive level and pin N to a ground level. If the XY Relays, or Rev Relays had been energized, pins 19 & 21 would keep them energized, until the oscillator stopped at the end of the index, at which

time pin H returns to a ground level and pin N to a positive level, releasing the relays.

3-3.16 Notch Hopper Card 12786

The Notch Hopper card operates in conjunction with the Edge Sensor card and is designed for use with slices having irregular edges. It enables the machine to step in the reverse direction for 10 steps, once the edge of the slice has been detected.

The card consists of flip flop Q4/Q5, a unijunction counter Q3 and a drive stage Q1/Q2. When the first edge of the slice is detected, the Intermediate flip flop in the Edge Sensor card is reset by the Z-STAGE RESTART pulse which produces a negative level at pin F. This turns on Q5 and turns off Q4 which releases the unijunction Q3. The machine reverses direction and each time the Z-Stage rises, a positive START TEST ENABLE pulse appears at pin P which enables Q1 and Q2 to turn on and charge the capacitor in the collector of Q2.

After 10 pulses have been received at pin P, the capacitor is sufficiently charged such that the unijunction Q3 fires and produces a positive pulse at pin D which sets the Intermediate flip flop in the Edge Sensor card. Pin F is at a positive level when the Intermediate flip flop is reset. The positive pulse from the unijunction also turns off Q5 and turns on Q4 which inhibits the unijunction.

The machine will continue in the reverse direction until the edge of the slice is detected. At this point, the Edge Sensor card produces another Z-STAGE RESTART pulse which resets the Intermediate flip flop and produces negative level at pin F. This turns off Q4 and releases the unijunction for another 10 count cycle.

3-3.17 Edge-Sensor Card (Dual Contact Closure Type) 12885

The Edge-Sensor card performs the following functions during the Automatic mode: (1) it provides AND/OR edge sensing for contact closure probes, (2) it issues a START TEST signal for the customer's equipment, (3) it energizes the XY relays for direction changes, and (4) it initiates a restart index cycle when the edge is sensed. If switch S1 is in the AND position, both probes must be off the slice to operate the circuit; if the switch is in the OR position, either probe will activate the circuit when it no longer contacts the slice.

When the Z-Stage rises, a ground level from the Z-Stage Drive card appears on the RESET EDGE SENSOR line at pin Y which cuts off Q6. The positive pulse from the collector of Q6 resets the Sensor flip flop Q4/Q5 by turning on Q5. The Relay Drive flip flop Q7/Q8 is also reset by this same positive pulse which turns on Q7. Assuming that switch S1 is in the AND position, transistors Q1 and Q2 will turn on when the probes detect the slice since the probe contacts open and remove the ground at pin J and K, respectively. This causes gate Z1D to produce a negative level which sets the Sensor flip flop by cutting off Q5. The positive level from the collector of Q5 sets the Intermediate flip flop Q9/Q10 by turning on Q9, which turns off Q10 to produce a positive level at pin F. The unijunction Q11 is normally held off; however, when the Z-Stage rises, the ground level is removed from the START TEST ENABLE line at pin P and the emitter capacitor C6 is allowed to charge. After approximately 60 to 70 milliseconds, Q11 fires to produce a START TEST signal at pin C for the test computer.

The above operation continues each time

the Z-Stage rises and the slice is detected by at least one of the edge sensing probes. If both edge sensing probes do not detect the slice when the Z-Stage rises, the ground level remains at pins J and K which hold Q1 and Q2 off. This causes gate Z1D to maintain a positive output level and the Sensor flip flop Q4/Q5 remains in the reset condition with Q5 on. This produces a ground level at pin C which inhibits the START TEST signal. When unijunction Q11 fires, it resets the Intermediate flip flop Q9/Q10 by turning on Q10. The positive pulse from the collector of Q9 resets the Relay Drive flip flop Q7/Q8 by turning on Q8. This applies a ground level on the ENERGIZE Y line at pin E which energizes the XY relays for a direction change. The positive pulse from unijunction Q11 also appears on the RESTART Z-STAGE line at pin M where it is utilized to initiate the Z-Stage restart cycle.

When the Z-Stage rises on the next cycle, the positive pulse from the collector of Q6 will reset the Relay Drive flip flop Q7/Q8 by turning on Q7 to remove the ground on the ENERGIZE Y line at pin E. If both edge sensing probes do not detect the slice, Sensor flip flop Q4/Q5 remains in the reset condition with Q5 on. The Intermediate flip flop remains in the reset condition with Q9 off; therefore, it has no effect on the Relay Drive flip flop. When the unijunction fires, a positive pulse appears at pin M for the RESTART Z-STAGE signal. No START TEST signal is produced for the customer's test equipment since pin C is held at ground when Q5 is on.

The above action continues until the first edge of the slice is detected. At this point, Q1 or Q2 turn on, depending on which probe detects the slice first, and allows gate Z1D to produce a negative pulse which sets the Sensor flip flop by

turning off Q5. The positive output from the collector of Q5 sets the Intermediate flip flop by turning on Q9. When unijunction Q11 fires, it will now produce a START TEST signal for the customer's test equipment. The Intermediate flip flop Q9/Q10 is now set; therefore, when the alternate edge of the slice is reached by both probes, it will set the Relay Drive flip flop Q7/Q8, thus energizing the XY relays for another direction change.

Transistor Q3 drives lamp DS1 which is located on the front of the electronics console and is used to align the edge sensing probes. When switch S1 is in the OR position either edge sensing probe will keep Q1 and Q2 off when the edge is detected, thus producing a positive level at the output of gate Z1D which turns on Q3 and DS1. When switch S1 is in the AND position, both edge sensing probes must not be contacting the slice before gate Z1D will maintain a positive level.

When the optional 10-step Notch Hopper card is used, the Sensor flip flop Q4/Q5 and the Intermediate flip flop Q9/Q10 are interconnected to the Notch Hopper card such that the Intermediate flip flop is not allowed to set until the Z-Stage has made 10 movements once the edge of the slice has been detected and the machine has reversed direction. This allows the machine to continue in the reverse direction for 10 steps after it has reached the edge of the slice. A variable Notch Hopper card permitting a 5 to 30 step delay is also available.

3-3.18 Logic Power Supply E60099

The Logic Power supply contains the constant current generators, the motor drive transistors, the +28 vdc regulator, +5 vdc regulator and a ± 8 vdc supply.

a. Constant Current Generators

When a positive level appears on J5-5, it turns Q10 on. The negative going signal on the collector of Q10 causes Q1 to turn on, which turns on Q3, turning on Q4. These 3 transistors begin driving until 3 amps is drawn through R7. Q9 begins turning on due to the signal present at its base, raising the voltage at the base of Q1, causing Q1, Q3, and Q4 to drive less. With Q4 driving less, Q9 begins turning off causing Q1, Q3, and Q4 to drive harder until 3 amps is drawn. The above sequence will continue thereby maintaining 60 vdc at 3 amps to pins 2 and 8 of the X motor connector as drive for the stepping motor. R21 is used to adjust the constant current to 3 amps.

b. Motor Drive Transistors

There are four drive transistors for each stepping motor. Their operation is identical; therefore only the X drive transistors (Q11, Q12, Q13, Q14) will be discussed. The Motor Drive card provides the sequencing pulses to these transistors such that two transistors are on at one time and two remain off. When a positive pulse appears at the base of a transistor, it turns on energizing the winding in its collector, thus stepping the motor. The two Zener diodes CR20 and CR21 limit the voltage spikes to approximately 200 volts.

c. +28 VDC Regulator

The +28 vdc regulator consists of CR1, Q1, Q2 and Q3. Twenty five VAC is fed from T1 of the main

power supply via pins 11 and 12 of J1 to the Bridge rectifier CR1. The regulator turns on to provide a +28 vdc level at pin 6 of J5. If the output from the regulator rises above 28 vdc, Q2 and Q3 begin turning off which causes Q1 to drive less and thus maintain the +28 vdc level. If the output drops below 28 vdc, Q2 and Q3 turn on harder which causes Q1 to drive more and raise the output back to the +28 vdc level.

d. +5 VDC Regulator

The +5 vdc regulator consists of Q4, Q5 and Q6. It receives +8V from the +8 vdc power supply at the emitter of Q4. The regulator turns on to provide a +5 vdc level at pin 22 of J5. If the output voltage rises above the 5 volt level, Q6 conducts less causing Q4 and Q5 to conduct less, thus maintaining the 5 volt level. If the output drops below 5 vdc Q6 conducts more causing Q4 and Q5 to conduct more and return the output to the +5 vdc level.

e. + 8 VDC Supply

The + 8 vdc supply consists of CR5, CR6, CR7, CR8. CR1 and CR2 are located on the logic power supply heat sinks. It receives a 17.8 V (CT) input from the main power supply via pins 13 and 15. One +8 vdc output is fed to the +5 vdc regulator. The other +8 vdc output is fed to pin 8 of J5. The -8 vdc output is fed to pin 23 of J5.

operating at 2500 steps per second. Each step is equivalent to 1.8° of mechanical rotation which is translated to 1.0 mil of horizontal travel when used with a 5-pitch lead screw or 0.5 mil when used with a 10-pitch lead screw. The motor has four windings; one end of each winding pair is tied to a common terminal, resulting in a 6 lead device.

The stepping motor is driven by sequencing pulses from the Motor driver card via four drive transistors which produce clockwise or counterclockwise motion. Two windings are energized at a time. Constant current generators are utilized to furnish 60 vdc to the windings of the motor and limit the current to 1.5 amps while stepping.

When table motion is required in any one of the three modes, the 60 vdc is switched to the winding of the motor by the High Voltage Control card. When the Motor Driver card advances the count, it causes one of its flip flops to toggle and enables the motor to rotate one step. When the motor is in the quiescent state, a holding current of 0.5 amp is applied to each winding which serves as a brake to hold the table in place.

3-3.19 Stepping Motor

The stepping motor is a permanent magnet bifilar DC stepping motor capable of

3-4 RELAY OPERATION

This section lists the conditions which activate the relays in the machine.

3-4.1 Stop-Start Relay

- a. AUTOMATIC, Start (then holds itself on after momentary start signal - no delay).
- b. MANUAL, X or Y Joy stick switched to any position (delayed). Deactivates when Joy stick released.

3-4.2 Index Relay and Light Relay

- a. MANUAL
- b. AUTOMATIC, Index Relay never activated in AUTOMATIC. Light Relay may be activated by override button. Relay remains actuated until switch is released.

3-4.3 XY Relays

- a. AUTOMATIC, Edge Sensor Activated.
- b. MANUAL, Y↑ or Y↓.

3-4.4 Reverse Relays

- a. MANUAL, Y↑
- b. MANUAL, Y not used; X →
- c. AUTOMATIC, Reverse Relay Drive activated.

3-5 RELAY FUNCTIONS

This section lists the function of the relays in the machine.

3-5.1 Start-Stop Relay

Pole (1) lights the STOP and START indicators and generates a negative pulse to start the oscillator in the Manual Mode. In Automatic, it unlocks the Inker drive with the negative pulse and raises the Z-Stage.

Pole (2) latches the Start-Stop Relay on when the START button is momentarily depressed in Automatic Mode.

Pole (3) opens the inhibit line to the Z-Stage so indexing stops after the count is complete when the Stop switch is depressed in the AUTOMATIC Mode.

Pole (4) Not used.

3-5.2 Index Relay

Pole (1) activates the Reverse Relay when in the Automatic mode when it is energized by the Reverse Relay Driver.

Pole (2) provides a path for the negative pulse, which raises the Z-Stage in the Automatic Mode when the START switch is depressed.

Pole (3) inhibits the user's START TEST signal when in the Manual modes. Inhibits the XY Relay Flip-Flop when in the Manual mode.

Pole (4) inhibits the Z-Stage driver in the Manual modes, so the Z-Stage cannot turn off the



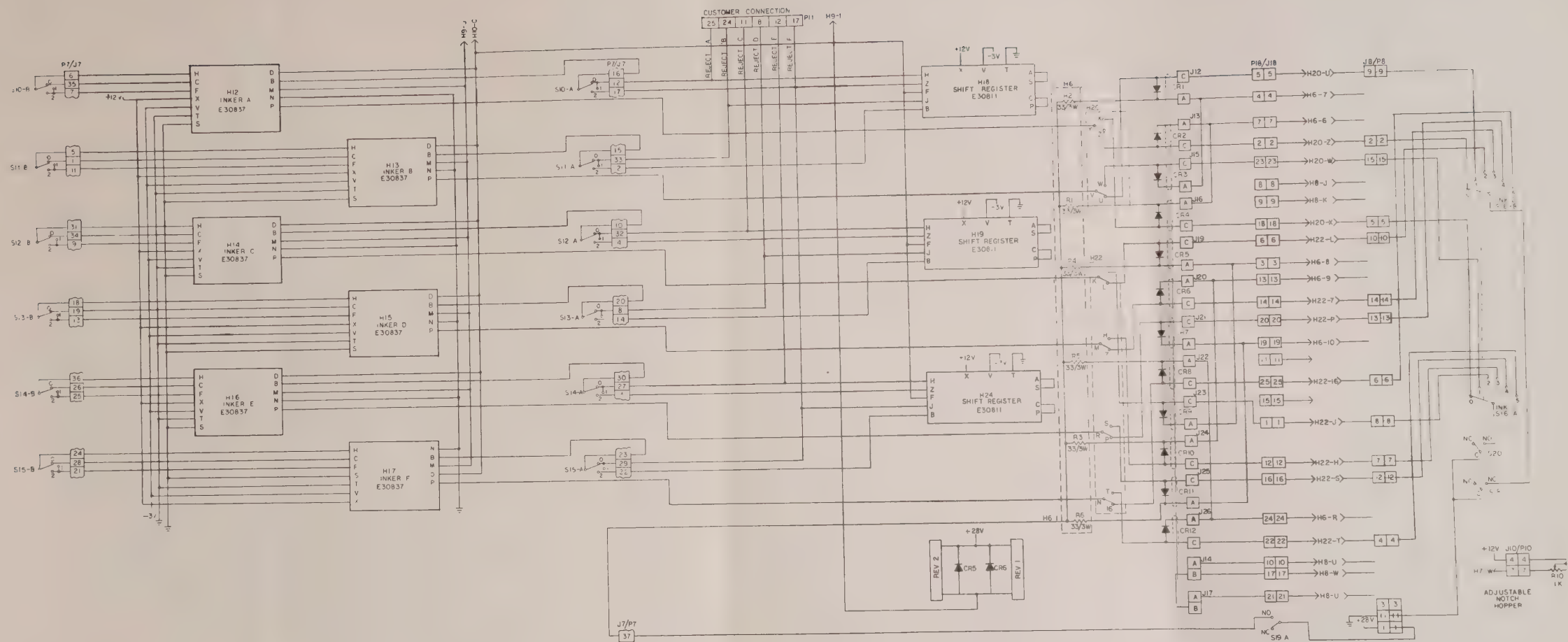


Figure 3-5 Automatic Mode
Inker Control Function



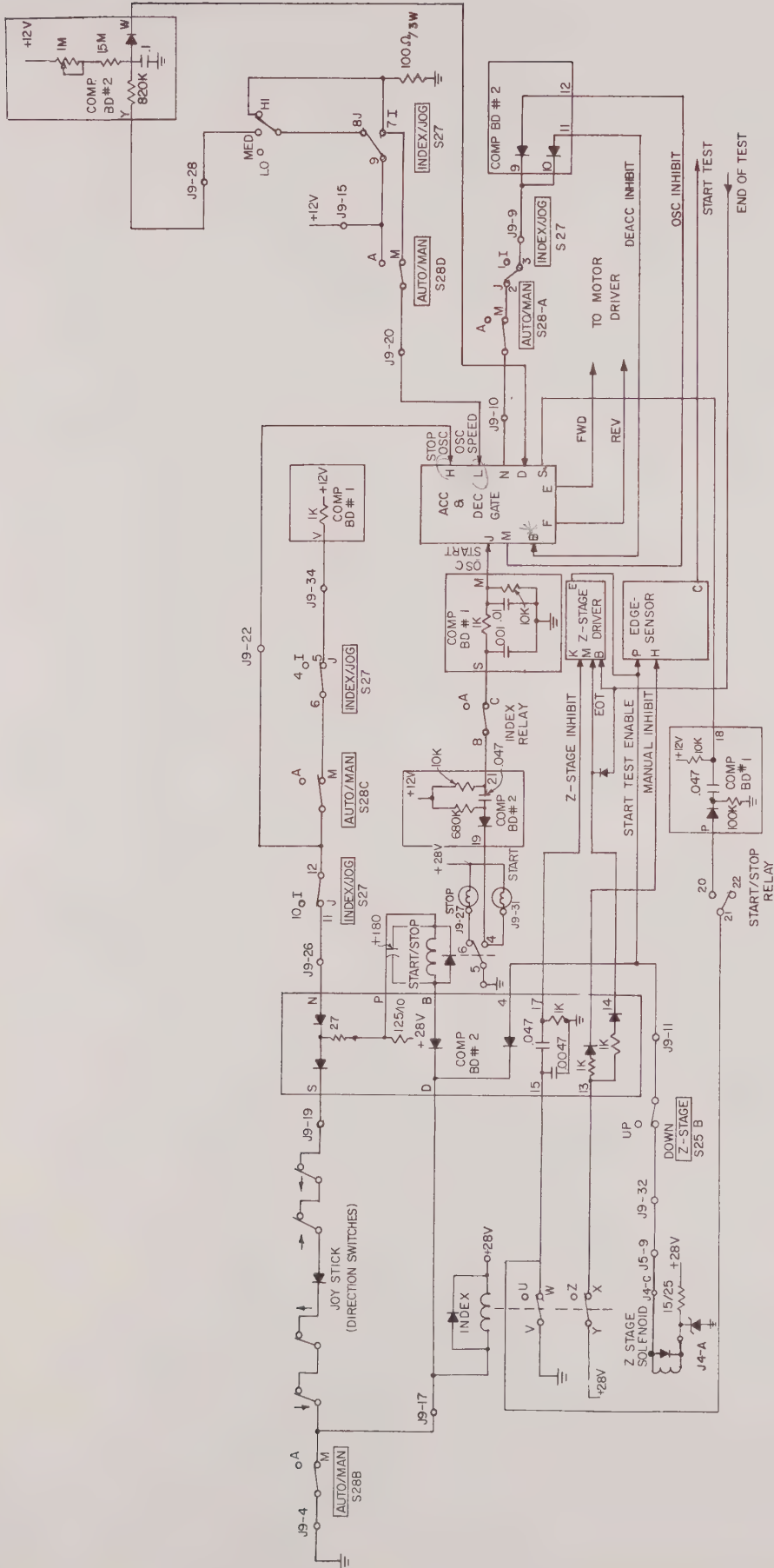


Figure 3-6 Manual Jog Mode Start/Stop Function



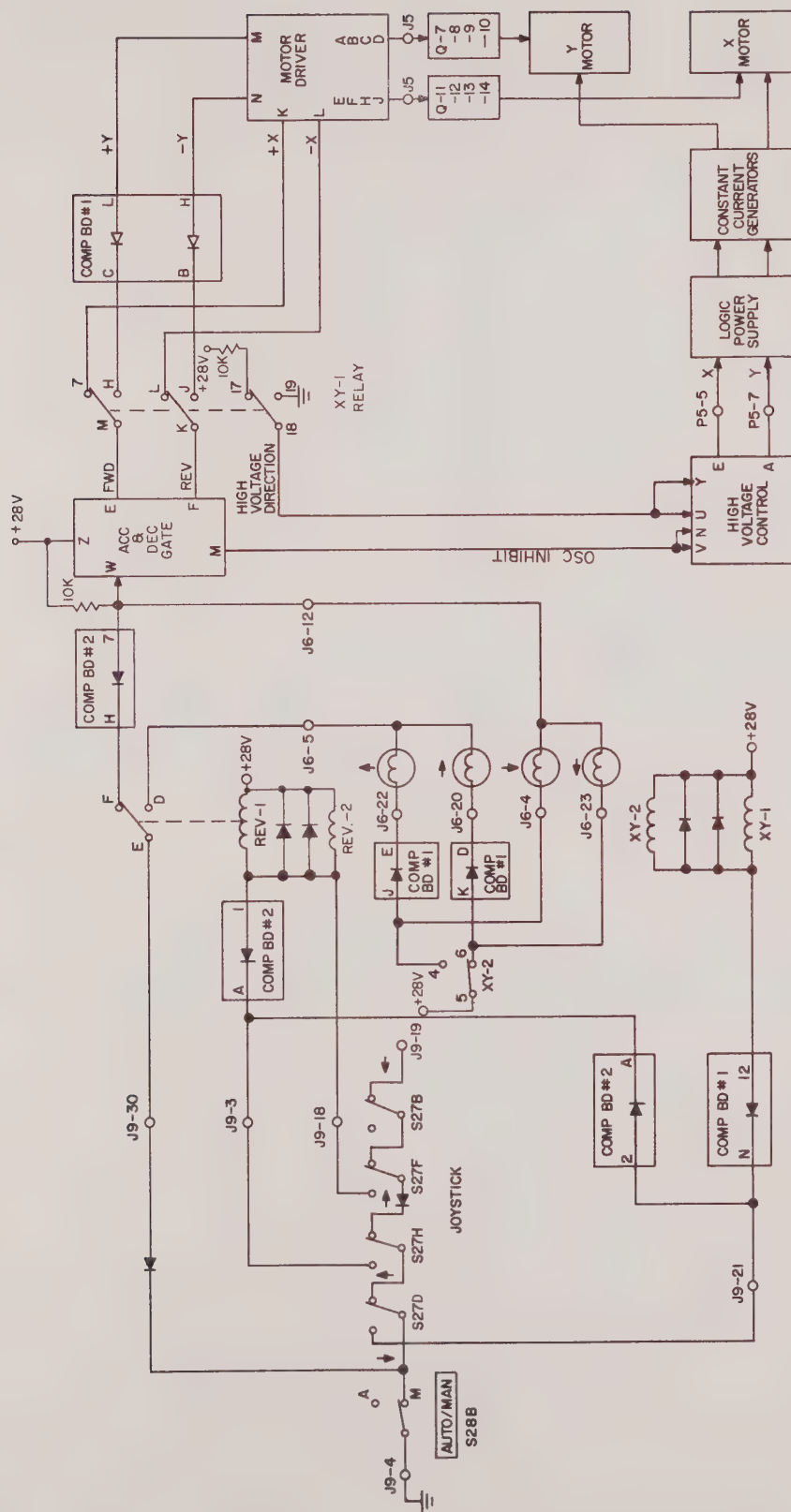


Figure 3-8 Manual Mode Direction Control Function

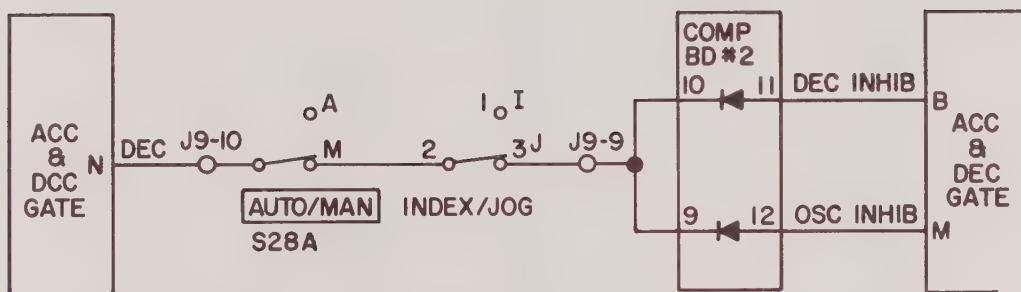


Figure 3-9 Manual Jog Mode Deceleration Inhibit Function

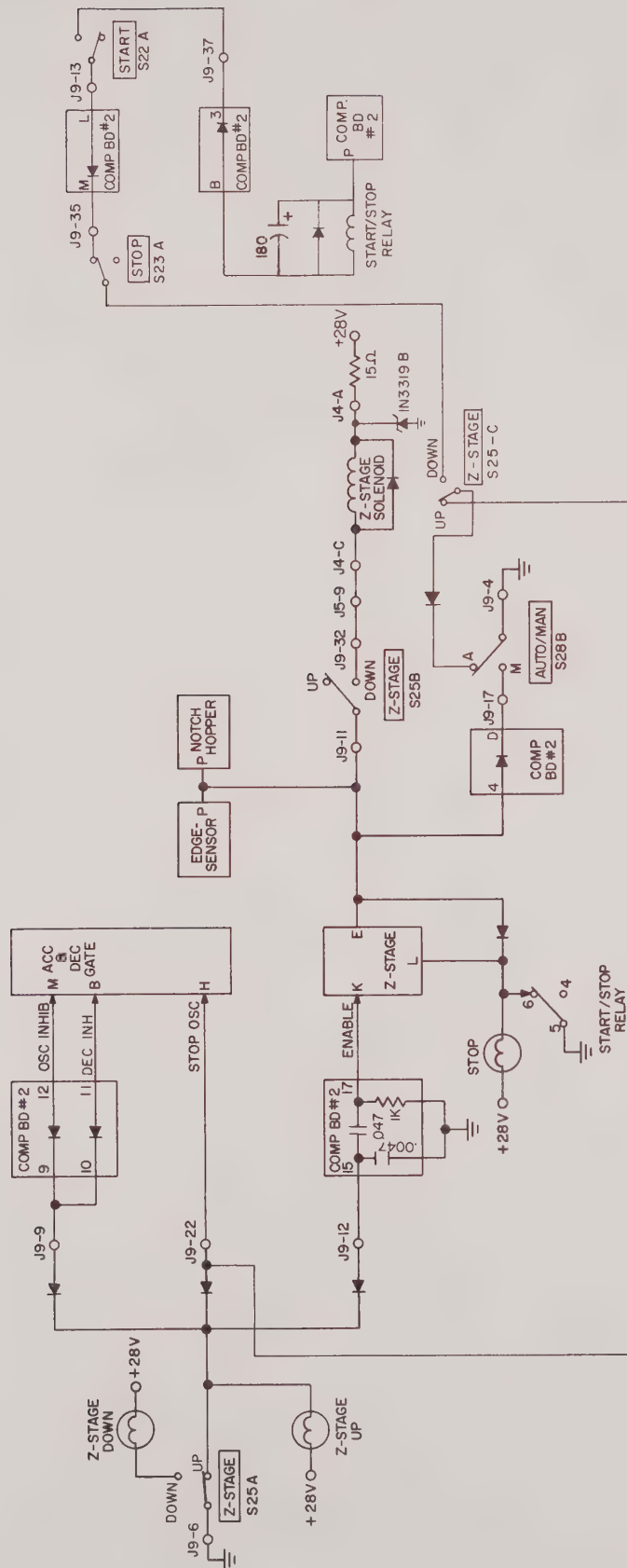


Figure 3-10 Manual Z-Stage Control Function

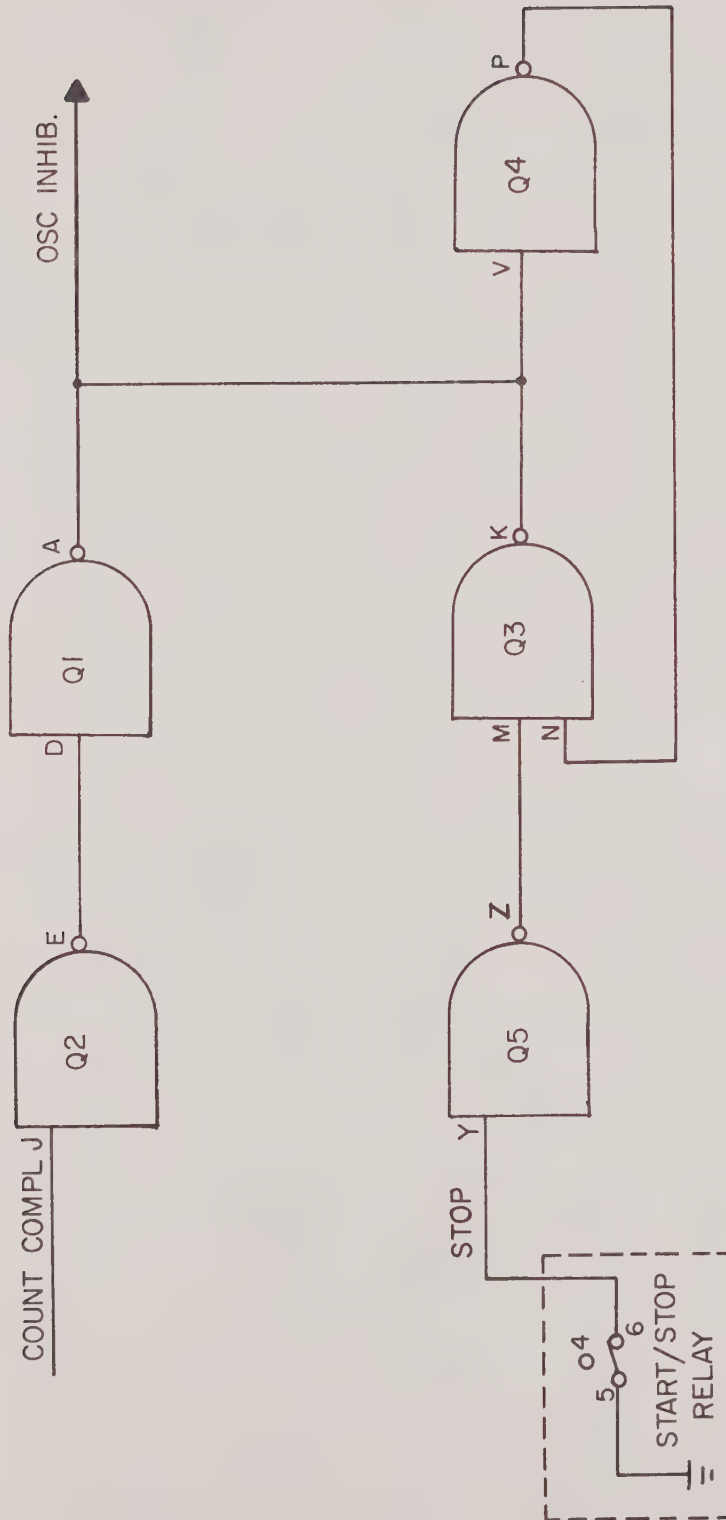


Figure 3-11 Lamp Driver Card Simplified Diagram

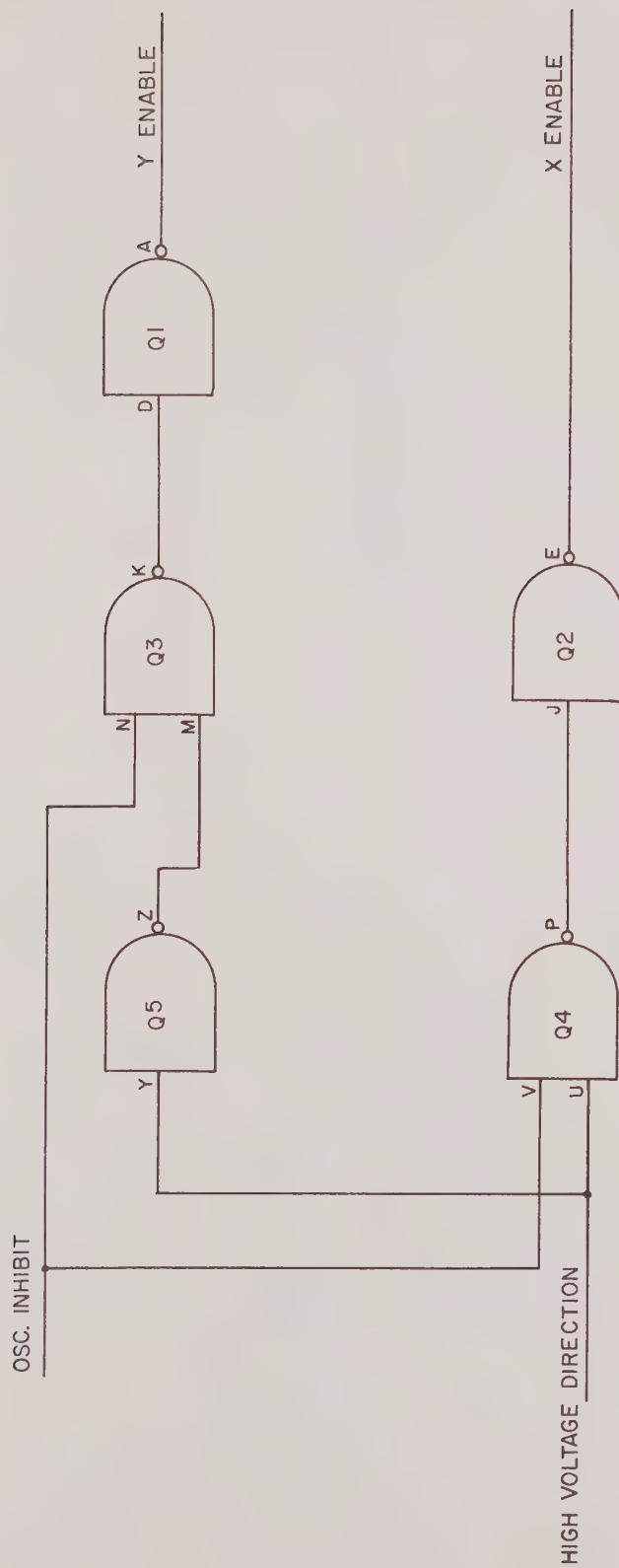


Figure 3-12 High Voltage Control Card Simplified Diagram

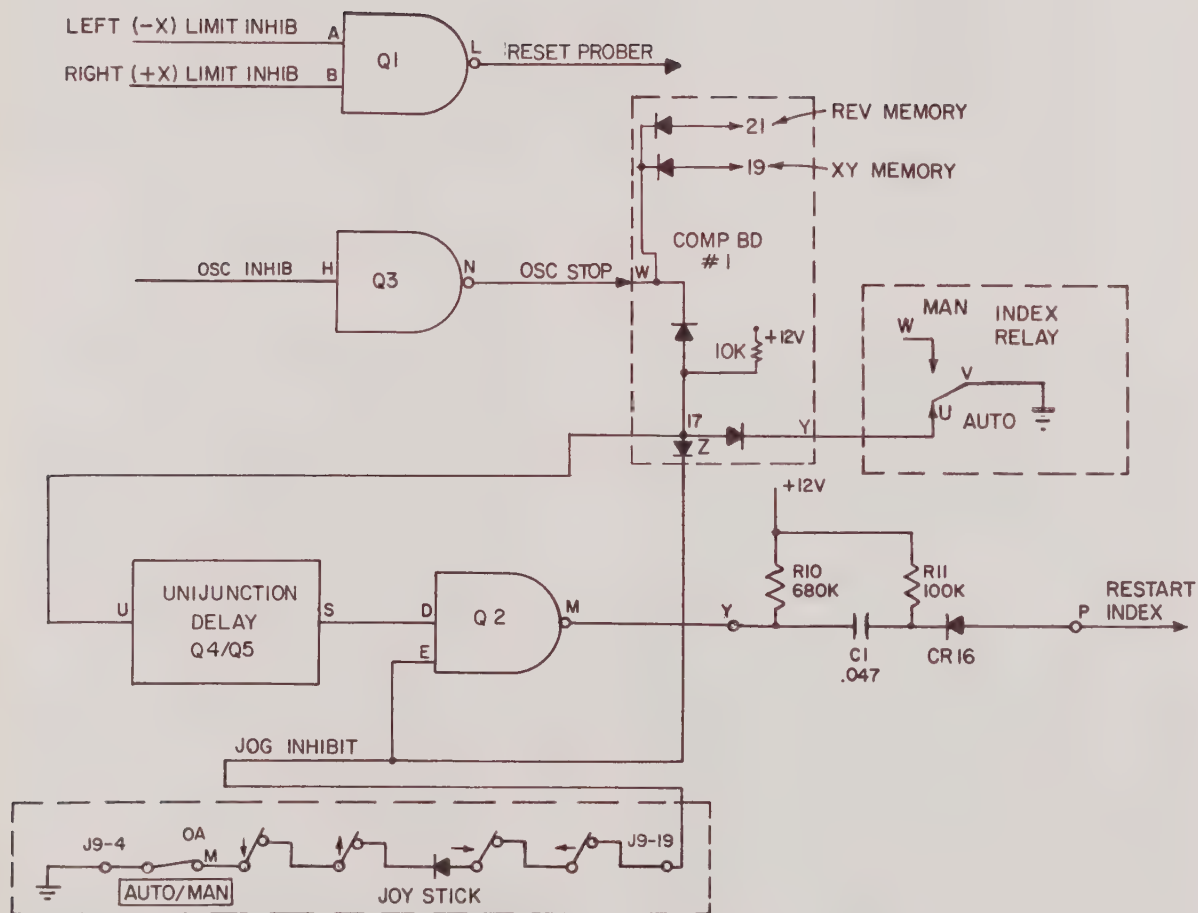


Figure 3-13 Index Pulser Card Simplified Diagram

SECTION 4

MAINTENANCE

4-1 INTRODUCTION

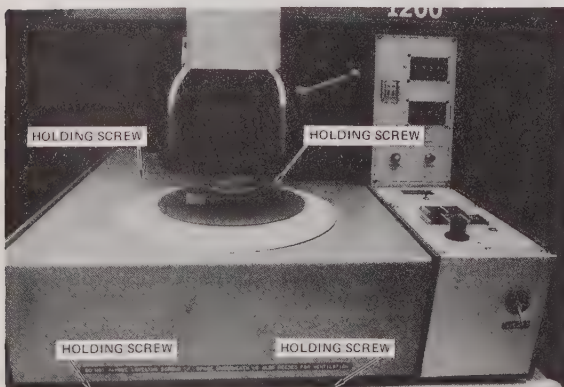
This section of the manual contains instructions on how to remove and replace major components of the standard Model 1200 machine. Also included are the mechanical adjustments that must be performed when a component is replaced.

4-2 REMOVAL AND REPLACEMENT PROCEDURES

Before attempting to remove a component, the technician should read the procedure for its removal carefully. Do not attempt to disassemble a component beyond that described in the procedure since certain components require special factory equipment to align them when they are reassembled.

4-2.1 Table Cover and Dust Cover Removal

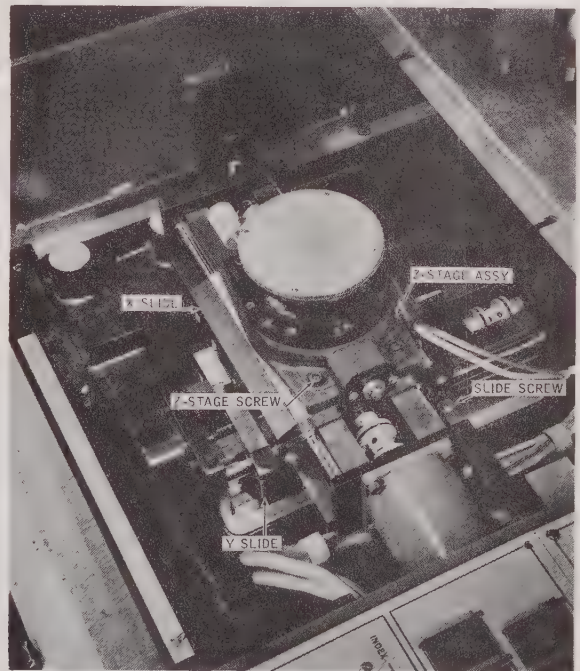
- Carefully, push the rubber dust cover down through the metal cover.
- Leave the rubber cover in place and remove the metal cover.



- Loosen the four screws holding the top front cover and remove cover.

4-2.2 XY Table Removal

- Remove covers per paragraph 4-2.1.
- Remove the four screws holding the Y axis slide to the machine base. Place machine in Manual Jog mode and use Joy stick to position the XY table.



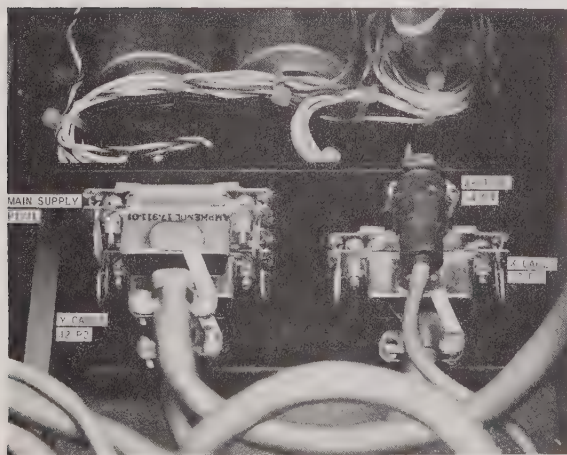
- Remove the four screws holding the Z-Stage assembly to the X axis slide. Remove the cable clamps and vacuum line on the base of the machine.
- Carefully lift the Z-Stage assembly and lay it to the rear of the machine.

- e. Remove power from the machine by pulling out the POWER circuit breaker on the Index panel and removing the AC line cord from the AC receptacle.

WARNING

The POWER circuit breaker does not remove power from all points in the machine; therefore, the AC line cord must be disconnected.

- f. Loosen the screws holding the Vacuum panel. Pull panel forward and up to remove, and lay it to the side of the machine.
- g. Loosen the four screws holding the Control panel. Pull up and lay to the side of the machine.
- h. Remove the X and Y cables from their connector mountings and identify each (X and Y) with a tag.



- i. Carefully lift the XY table out of the machine.

CAUTION

Do not chip or scratch the precision ground flat surfaces of the XY table.

- j. Replacement of the XY table is the reverse of steps a. through i.

- k. Level Z-Stage per paragraph 4-3.3.

4-2.3 Motor Removal and Replacement

- a. Remove covers per paragraph 4-2.1.
- b. Place the machine in the Manual Jog mode and position the XY table with Joy stick until there is sufficient clearance for access to the two set screws on the flexible coupling between the motor and lead screw bearing block.



CAUTION

The leads must be identified since the cathode of the solenoid diode must be connected to the + side of the line when replacing the Z-Stage assembly.

- d. Remove the vacuum chuck from the Z-Stage assembly and disconnect the vacuum line.
- e. Remove the four socket head screws holding the Z-Stage assembly to the X table slide.
- f. Carefully remove the Z-Stage assembly.
- g. Install a new Z-Stage assembly in the reverse order of steps a. through f.
- h. Perform the Z-Stage alignment procedure per paragraph 4-3.3.

4-3 MECHANICAL ALIGNMENT PROCEDURES

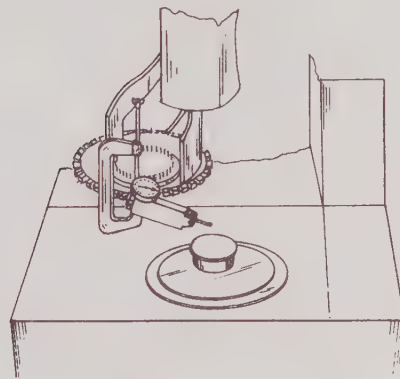
The following alignment procedures are to be performed whenever the lead screw, XY table slides or the Z-Stage assembly are replaced in the machine. A .00005 dial indicator, one 1" precision gauge block, two 1/2" blocks, three 1/4" blocks and two sided adhesive tape are required.

4-3.1 Spring Plunger Screw Adjustment (screw to table only)

NOTE

This procedure is to be performed, when replacing lead screws or when back-lash is suspected.

- a. Using double-sided adhesive tape, mount a 1/2" gauge block on the vacuum chuck.
- b. Mount a .00005 dial indicator on the probe mounting ring so that the stylus of the indicator is low enough to contact the gauge block.



- c. Apply a force on the table towards the screw mounting block in order to depress the spring loaded plunger. The dial indicator should deflect a maximum of .0015 and a minimum of .001.

NOTE

When the pressure is released, the dial indicator should return to its original setting.

- d. If the spring loaded plunger must be adjusted, remove the spring plunger block from the table.
- e. Turn the spring plunger screw in the clockwise direction to reduce the deflection and counterclockwise to increase it.

CAUTION

Do not attempt to adjust the spring plunger screw while it is coupled to the table. This will destroy the factory adjusted pressure setting of the spring plunger. The three spring plungers on the split nut of the lead screw are not to be tampered with under any circumstances.

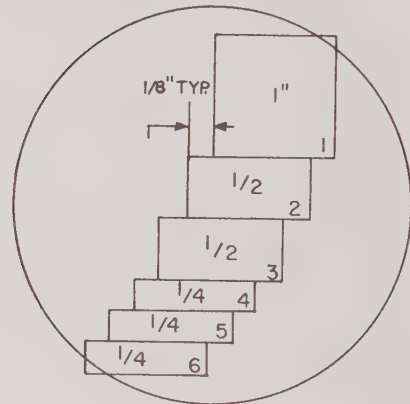
- f. Replace the spring plunger on the slide and repeat step c until the proper reading is achieved.
- g. Place the machine in the Manual Jog mode and position the XY table until the dial indicator deflects to approximate center scale. Record the reading on the indicator.
- h. Place the machine in the Manual Index mode and set the INDEX switches for a 25 mil index. Index the table so that the gauge block moves away from the ball of the indicator.
- i. Index the table a second time so that the gauge block moves toward the ball of the indicator. The new reading should be the same as that of step g.

4-3.2 XY Table Accuracy Alignment

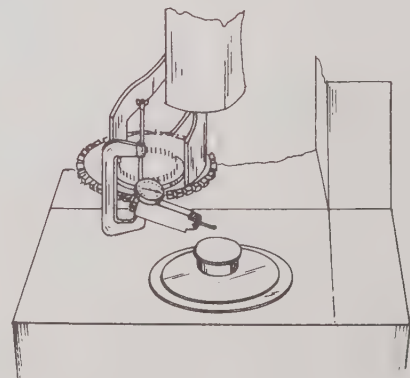
NOTE

This procedure is to be performed when the lead screws are replaced, the screw bearings are disturbed or the table accuracy is to be checked.

- a. Using the double sided adhesive tape, mount the gauge blocks to the Vacuum Chuck top plate in a step pattern (see diagram) be sure the blocks are secure.



- b. Clamp (securely) the .00005 increment dial indicator to the probe mounting ring so that the stylus of the dial indicator can make contact with the gauge blocks on the Vacuum chuck top plate.



- c. Set the machine in the Manual Jog (medium speed) mode and drive the XY table back and forth so that the gauge blocks are riding parallel to the driven axis.

- c. Remove the XY table per paragraph 4-2.2, but do not remove Z-Stage from the X slide.
- d. Unsolder the six color-coded wire leads to the motor. Pull each lead through the grommet in the bracket and identify with tags.
- e. Loosen the two set screws on the flexible coupling at the lead screw end of the coupling.
- f. Remove the four socket cap screws holding the motor on to the end plate and carefully remove the motor.

CAUTION

Do not disturb the bearings. If the bearings are disturbed, the slide must be realigned and stepped off.

- g. Replacement of the new motor is the reverse of steps a. through f.

NOTE

The set screws on the flexible coupling must be on the flats of the lead screw when reassembling the motor.

- h. Replace XY table per paragraph 4-2.2 (i thru a).

4-2.4 Lead Screw Removal

- a. Remove covers per paragraph 4-2.1.
- b. Place the machine in the Manual Jog mode and drive the appropriate slide to its limit on the motor end.

- c. Remove the two allen head screws holding the spring plunger block and remove block.



- d. Push the table slide away from the motor end while driving it towards the lead screw mounting block.
- e. Loosen the two set screws holding the flexible coupling.

NOTE

If the X lead screw is to be removed, the XY table must be removed per paragraph 4-2.2 before performing step f. Do not remove the Z-Stage from the X slide.

- f. Remove the four allen head screws holding the lead screw bearing block.
- g. Push the table slide towards the motor mounting block and carefully slide the lead screw out.

- h. Replace lead screw per paragraph 4-2.5.

4-2.5 Lead Screw Replacement

- a. Move the split nut to within $3/4$ " from the end of the threads on the lead screw at the lead screw bearing block end, rotating both halves of nut together. The stabilizer pins should be lined-up with each other.

CAUTION

The three spring plungers in the split nut should not be tampered with under any circumstances.

- b. Guide the stabilizer pins (barrel shaped) on the split nut into the machined slot in the under side of the slide.
- c. Guide the end of the lead screw shaft into the bearing support block and manipulate the flexible coupling so the end of the lead screw shaft is seated, and the flats are lined up with setscrews in the flexible coupling. Tighten setscrews.
- d. Tighten the four 10-32 socket head cap screws holding the lead screw bearing block in place. (stagger torque the screws) and tighten the set screws in flexible coupling.
- e. Install the spring plunger block assembly and tighten with the two 8-32 socket head cap screws.
- f. Perform the procedure for checking table accuracy. Refer to paragraph 4-3.2.

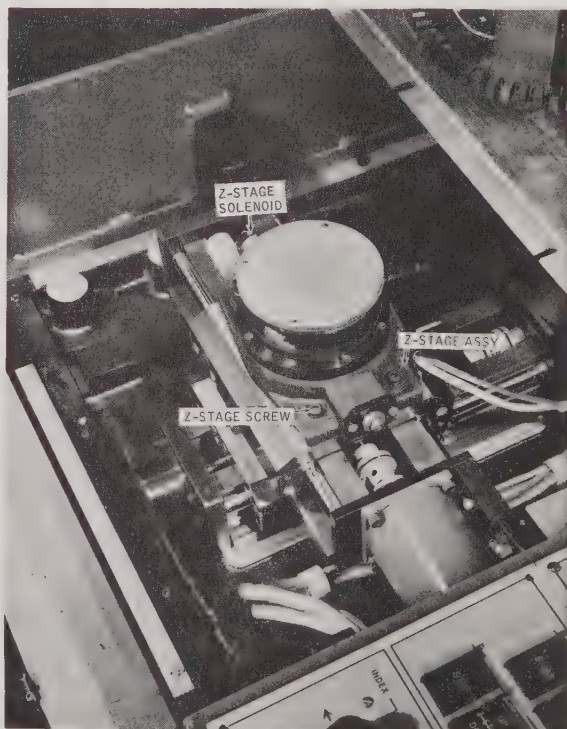
4-2.6 Z-Stage Removal and Replacement

- a. Remove covers per paragraph 4-2.1.
- b. Remove power from the machine by pulling out the POWER circuit breaker on the Index panel and remove the AC line cord from the AC receptacle.

WARNING

The POWER circuit breaker does not remove power from all points in the machine; therefore, the AC line cord must be disconnected.

- c. Disconnect the leads from the Z-Stage solenoid and identify with a tag. Disconnect the cable clamps.



NOTE

If the dial indicator deflects, adjust the deflection out by rotating the vacuum chuck with the Orientation knob until the deflection is eliminated and the blocks are running in true parallel to the driven axis.

- d. Set the machine in the Manual Jog (slow speed) mode and position the table until the stylus of the indicator contacts the first gauge block and set the indicator at zero.
- e. Set the thumbwheel switches on the Index panel at .125 (X & Y axis).
- f. Set the machine in the Manual Index mode and back off the gauge block two steps. Reverse direction and go forward two steps; the reading on the dial indicator should be zero.

NOTE

If reading is not zero, see step i.

- g. Place the machine in the Manual Jog mode and drive the XY table parallel to the #1 gauge block until the stylus of the indicator clears the end of the #1 gauge block (1" block). The indicator should not have shown any deflection while riding parallel and making contact with #1 block.
- h. Set the machine in the Manual Index mode. Drive the XY table eight complete indexes perpendicular to the previous axis until the next gauge block is contacted. The reading on the dial indicator should be zero $\pm$.0001 per inch of travel.

- i. Repeat steps g and h until all six gauge blocks are contacted. If the error is greater than .0003 over the six gauge blocks, then proceed as follows:

NOTE

The 1/2" blocks require 4 indexes and the 1/4" blocks require 2 indexes.

- 1. Loosen the bolts holding the lead screw bearing block (opposite end of motor)
- 2. Move the screw bearing block until the error noted on the dial indicator is divided in half.
- 3. Tighten the bolts holding the screw bearing block.
- 4. Repeat steps c thru i until the error is eliminated.
- 5. Check Spring Plunger pressure on both X & Y axis; deflection should be .0015 on both axis.
- j. Rotate the vacuum chuck 90° and repeat steps c. through i. and check the other axis of travel.
- k. Remove the gauge blocks from the vacuum chuck. Remove the vacuum chuck top plate and clean with alcohol to remove all foreign matter. When chuck top plate is completely clean, replace on vacuum chuck and check alignment per 4-3.3.
- l. Remove dial indicator and put a slice in probing position; align and probe the complete slice. Monitor the complete slice to be sure of the XY table accuracy.

4-3.3 Z-Stage Assembly Leveling & Alignment

NOTE

This procedure is to be performed when replacing vacuum chuck, or Z-Stage.

- a. Place the machine in the Manual Jog mode, and check that the vacuum chuck is firmly seated.
- b. Mount a dial indicator on the probe mounting ring so that the stylus of the indicator just contacts the chuck enough to deflect the dial to the center of its travel.
- c. Disconnect one Solenoid lead so that Z-Stage is in the up position (protect loose lead from shorting out against any metal parts)
- d. Drive the table in the X direction; the total deflection of the indicator should be less than .0005.
- e. Drive the table in the Y direction; the total deflection of the indicator should be less than .0005.
- f. If the Z-Stage assembly is not level within the above tolerances, loosen the mounting screws of the assembly and insert shim stock at the mounting screws. A 0.003" sheet stock will correct approximately 0.001" of error.
- g. Connect the Solenoid lead removed in step c.

4-4 ELECTRICAL CALIBRATIONS

The following electrical calibrations require

an accurate VOM (Simpson 260 or equivalent) and a dual-trace oscilloscope. All of the printed circuit adjustments are accessible by means of the card extender which is provided with each machine.

4-4.1 +12 VDC Power Supply Regulator

- a. Connect a voltmeter to pin X (+12 VDC) and pin T (grd) of the power supply regulator card located in position H27 of the electronics console.
- b. Adjust R10 on the card until the meter reads +12 VDC. R10 is the top potentiometer.
- c. Remove the probe from pin X and connect it to pin V (-3 VDC) of the card.
- d. Adjust R19 on the card until the meter reads -3 VDC. R19 is the bottom potentiometer.
- e. Repeat steps a through d until both voltages are correct.

4-4.2 +5 VDC Power Supply Regulator

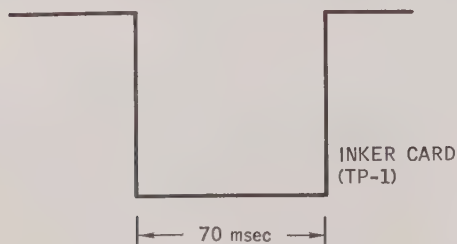
- a. Connect a voltmeter to pin R (+5.5 VDC) and pin T (grd) of the power supply regulator card located in position H28 of the electronics console.
- b. Adjust R6 on the card until the meter reads +5.5 VDC. R6 is the potentiometer closest to the rear of the machine.
- c. Remove the probe from pin R and connect it to pin V (-3 VDC) of the card.
- d. Adjust R20 on the card until the meter reads -3 VDC. R20 is the

potentiometer closest to the front of the machine.

- e. Repeat steps a through d until both voltages are correct.

4-4.3 Magnetic Inkers

- a. Connect the Customer's Test Box to the Customer Connector.
- b. Set the Inker digiswitches to the "1" setting.
- c. Connect a set of Inkers to the A-1 and A-2 Inker connectors.
- d. Place the INKER switch in the ON position.
- e. Connect the scope probe to TP-1 of the first Inker Drive card in the machine.
- f. Connect the "sync" input of the scope to the Inker card pin P. Trigger on the negative pulse at pin P.
- g. Place the machine in the Automatic mode.
- h. Repeatedly depress the INKER switch and then the STEP switch on the Customer's Test Box. One inker should activate each time.
- i. Adjust the trimpot on the Inker Drive card until a 70 msec pulse is observed on the scope. Refer to figure below.



- j. Reverse the direction of the machine and check that the other inker operates properly.

- k. Perform the above adjustments on each set of 2 inkers operating with the Prober.

4-4.4 Motorized Inker

- a. Perform steps 4-4.3a through 4-4.3h.
- b. Adjust the 20 K ohm trimpot on the Inker Drive card until the inker operates twice each time. Then back off the trimpot one full turn.
- c. Reverse the direction of the machine and check that the other inker operates properly. If double inking occurs, repeat the above steps on this Inker. Then recheck the first inker.
- d. Perform this adjustment on each set of 2 Inkers operating with the machine.

NOTE

If the inker drive pulse exceeds 100 msecs, the leading inker may also receive a short pulse when the machine first leaves the edge of the slice. This usually is not troublesome, but can be avoided by shortening the inker drive pulse to 100 msec using the 20K ohm trimpot on the Inker Drive card.

When using the motorized inkers, the inker drive pulse width should be monitored at the

collector of Q1 on the Inker Drive card -- not at the inker input lead. (The pulse appearing at the motorized inker input lead is longer than the drive pulse because the cam actuated microswitch grounds the input lead when returning the inker to the uppermost position.) The inker drive pulse width can be monitored at the input lead the magnetic inkers since the microswitch assembly is not used.

TAC Engineering should be consulted if it is difficult to obtain the proper adjustment.

- b. Place the INDEX/JOG Switch in the Jog position.
- c. Place the Speed switch in the HI position.
- d. Connect a scope probe to pin K of the Acc & Dec Gate card.
- e. Depress the Joy Stick in the +X direction and let the table run into the +X limit switch.
- f. Keeping the Joy Stick depressed, adjust R54 until a pulse rate of 2000 pps appears on the scope. R54 is the top trimpot.

4-4.5 Slow Jog Adjustment

- a. Place the machine in the Manual mode.
- b. Place the INDEX/JOG switch in the Jog position.
- c. Place the Speed switch in the LO position.
- d. Connect a scope probe to H5 pin K of the electronics console.
- e. Depress the Joy Stick in the +X direction.
- f. Adjust the 1 meg trimpot R7 until approximately 5 pps appears on the scope.

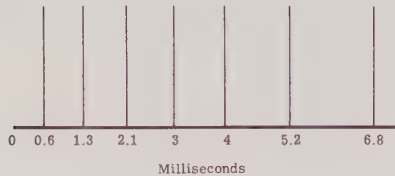
4-4.6 Acc & Dec Gate Card Speed Adjustment

- a. Place the machine in the Manual mode.

4-4.7 Acc & Dec Gate Card Deceleration Adjustment

- a. Place the machine in the Manual mode.
- b. Place the INDEX/JOG switch in the INDEX position.
- c. Connect a scope probe to the junction of R43 and the collector of Q10.
- d. Connect the "sync" input of the scope to the collector of Q6. Set the vertical sensitivity to 1V/cm and the sweep speed to 1 msec/cm. Trigger from the positive going signal at this point.
- e. Depress the Joy Stick in the +X direction and let the table run into the +X limit switch.
- f. 1. For a 5 pitch machine (1 mil step):
Keeping the Joy Stick depressed,

adjust R19 until the last pulse appears 6.5-7 milliseconds after the sweep begins. R19 is the bottom trimpot. Refer to figure below.



2. For a 10 pitch machine (.5 mil step):

Keeping the Joy Stick depressed, adjust R19 until the last pulse appears 6 milliseconds after the sweep begins. R19 is the bottom trimpot.

g. Repeat 4-4.6.

4-4.8 High Voltage Power Supply +60 VDC Adjustment

- a. Pull the circuit breaker so that the machine is off.
- b. Place the machine in the Manual mode.
- c. Place the INDEX/JOG switch in the JOG position.
- d. Place the Speed switch in the LO position.
- e. Remove the four screws holding the Joy Stick panel.
- f. Lift out the panel and lay it to the side of the machine. Do not disconnect the panel.
- g. Remove F3 from the Logic Power Supply. F3 is the fuse located furthest towards the front of the machine.

- h. Connect a VOM (Simpson 260 or equivalent) across the fuse holder.

CAUTION

Be sure the meter is set on the 10 AMP scale.

- i. Depress the circuit breaker.

CAUTION

If the readings in the following steps are greater than 4 amps, release the joy stick immediately and turn the appropriate trimpot two full turns then repeat the steps.

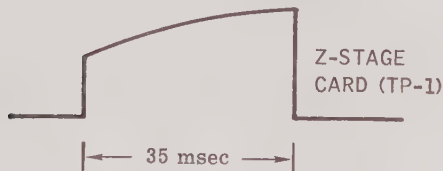
- j. Depress the Joy Stick in the X direction so that the table is continuously moving.
- k. Adjust R-21 on the Logic Power Supply Board until 2.8 amps are read on the meter.
- l. Depress the Joy Stick in the Y Direction so that the table is continuously moving.
- m. Adjust R-14 on the Logic Power Supply Board until 2.8 amps are read on the meter.

4-4.9 Z-Stage Drive Card Adjustments

There are two adjustments on the Z-Stage Drive card. One varies the time from the Z-Stage going down to the start of the X or Y motor. The other is not used.

- a. Connect an oscilloscope probe to TP-1 of the Z-Stage Drive card. TP-1 is located towards the rear of the machine.

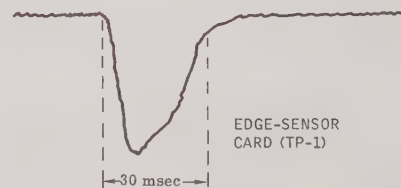
- b. Connect the "sync" input of the scope to the Z-Stage Drive card pin E (H10-E). Trigger on the negative pulse at pin E.
- c. Disconnect the tester.
- d. Place the machine in the Automatic mode and depress the START switch.
- e. Depress the STEP switch.
- f. Adjust R1 on the card until a 35 millisecon positive pulse is observed on the scope. See figure below.
- f. Set the scope for a vertical sensitivity of .5V/cm and a sweep rate of 20 msec/cm.
- g. Connect input A of the oscilloscope to TP-1 of the Edge Sensor card and input B to TP-2.
- h. Place the probe in the Automatic mode.
- i. Depress the START switch.
- j. Depress the STEP switch. The Z-Stage should lower and raise under the Edge Sensor probe.



- k. Observe the negative pulse at TP-1.
- l. Rotate the micrometer located on the vertical column to the left until the pulse at TP-1 disappears. This indicates that the probe is no longer contacting the wafer.

4-4.10 Strain Gage Calibration

- a. Place a slice on the vacuum chuck. Place the machine in the Manual Jog mode and position the slice directly under the edge sensor probe.
- b. Remove the Motor Drive PC board from slot H-25.
- c. Set the probe force screw a turn beyond the point at which the probe nylon stop rests on the body shelf.
- d. Set the front panel dials to 1 mil.
- e. Connect the "sync" input of a dual trace oscilloscope to pin E of the Z-Stage Drive card located in slot H-10. Trigger on the positive pulse at pin E.
- m. Rotate the micrometer .004 inches to the right.
- n. If excessive ringing is observed at TP-1, adjust the force screw until the ringing disappears. Refer to figure below.

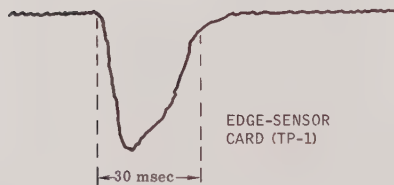


4-4.11 Z-Stage Damping

This calibration procedure adjusts the damping of the Z-Stage by means of the Z-Stage dashpot.

- a. Perform Section 4-4.10.

- b. Place the Prober in the Automatic mode.
- c. Depress the START switch.
- d. Set the Edge Sensing probe for a 4 mil overtravel.
- e. Connect a scope probe to TP-1 on the Edge Sensor card H8.
- f. Connect the "sync" input of the scope to H10-pin E. Trigger on the positive going signal present at pin E.
- g. Repeatedly depress the STEP switch and monitor the signal present at TP1.
- h. Adjust the Z-Stage so that the trailing edge of the pulse on TP-1 occurs approximately 70 millisecon after the sweep starts. Refer to figure below.



4-4.12 Edge-Sensor Card Alignment

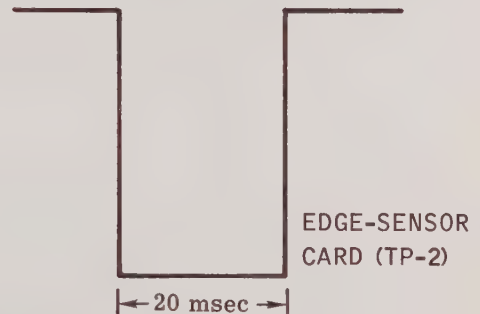
The following adjustments are only for strain-gauge type edge-sensing.

There is one trimpot (2K ohms) and two test points on the Edge Sensor card (TP-2 is located at the rear of the card).

4-4.13 Edge Sensor Card Calibration (Single Edge Sensing)

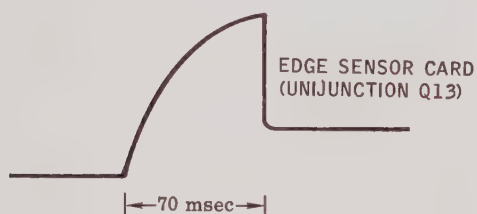
This calibration adjusts the gain of the Edge Sensor Amplifier.

- a. Perform steps 4-4.10 a through 4-4.10 n.
- b. Depress the STEP switch and observe the pulse at TP-2. Rotate the 2000 ohm trimpot on the Edge Sensor card until the pulse at TP-2 is approximately 20 msec. It is important that the pulse at TP1 is longer than that at TP2. Refer to figure below.



- c. Disconnect the scope from TP-1 and connect it to the emitter of the uni-junction transistor Q13 on the Edge Sensor card. Set the scope for a vertical sensitivity of 5V/cm and a sweep rate of 20 msec/cm.
- d. The increasing slope of the capacitor voltage should end 65-75 millisecon after the sweep starts. The value of the capacitor at this junction should be changed if the charging rate is improper. This capacitor was

selected at the factory and ordinarily should not require readjustment. Refer to figure below.



4-4.14 Edge Sensor Card Calibration (Dual Edge Sensing)

- a. Perform steps 4-4.10 a through 4-4.10 n.
- b. Depress the STEP switch and observe the pulse at TP-2. Rotate the 2000 ohm trimpot on the Edge Sensor card until the pulse at TP-2 is approximately 30 msec.
- c. Disconnect the scope from TP-1 and connect it to the emitter of the unijunction transistor Q13 on the Edge Sensor card. Set the scope for a vertical sensitivity of 5 V/cm and a sweep rate of 20 msec/cm.
- d. The increasing slope of the capacitor voltage should end 65-75 millisecond after the sweep starts. The value of the capacitor at this junction should be changed if the charging rate is improper. This capacitor was selected at the factory and ordinarily should not require readjustment. Refer to figure above.

4-5 CLEANING PRECAUTIONS HIGH DENSITY PROBES

Care must be taken when cleaning the high density probe and edge sensor bodies, which are made of a material sensitive to strong cleaning agents.

DO NOT attempt to wash or soak these bodies in any solution stronger than ethyl alcohol since deterioration of material will result. A plain soap and water solution should be sufficient to remove most dirt from the body. If a stronger cleaning agent is desired, ONLY no. 1 or no. 3 denatured ethyl alcohol is recommended.

SECTION 5

TROUBLESHOOTING AND LUBRICATION

5-1 INTRODUCTION

This section of the manual contains a listing of helpful hints that the technician can utilize to isolate certain malfunctions that may occur. Also included is the lubrication schedule for the machine.

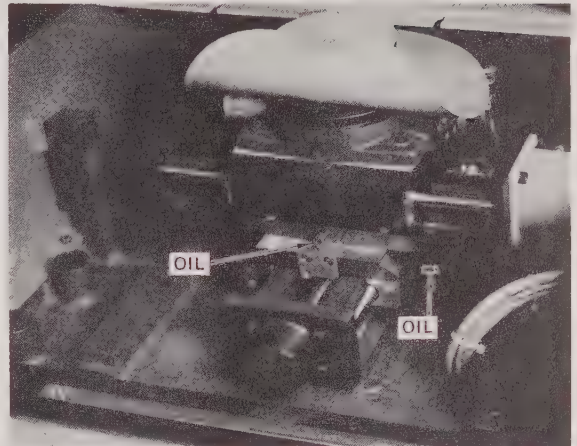
5-2 TROUBLESHOOTING

Table 5-1 contains a list of possible malfunctions and their probable causes which the technician should refer to whenever machine problems occur. The table does not include every possible malfunction; however, it will serve as a starting point and assist the technician in solving the majority of troubles.

5-3 LUBRICATION

The standard Model 1200 machine requires a minimum of maintenance to keep it operating. There are only two areas that require lubrication: the lead screw and the xy slides.

a. Remove the metal dust cover.



- b. Loosen the screws holding the table cover and remove.
- c. Lubricate the lead screw reservoirs every week with no. 10 non-detergent oil.
- d. Light brush the xy slides with no. 10 non-detergent oil every month.

Table 5-1 Troubleshooting Guide

Problem	Probable Cause	Remedy
1. Machine will not move	Z-Stage is up	Depress Z-STAGE switch
	+5.5 VDC missing	Replace 5.5 VDC Regulator (H-28) card
	+60 VDC fuse blown	Replace 3 amp fuse
	No start pulse at pin J of Acc & Dec Gate card (H-5)	Replace Start/Stop relay on card (H-22) Replace Component Board No. 2 (H-9) Replace Z-Stage Drive card (H-10)
	No pulses at pins E or F of the Acc & Dec Gate card (H-5)	Replace card
	No pulses at pins M,N,K, or L of the Motor Drive card (H-25)	Replace XY Relays (H-20) Replace Component Board No. 1 (H-6)
	No pulses at pins A,B,C, D, E, F, H, or J of the Motor Drive card (H-25)	Replace card
2. Table moves erratically in both X & Y directions	+5 VDC missing from Motor Drive card (H-25) Pin 14	Replace Logic Power Supply card
	+60 VDC fuse blown	Replace 3 amp fuse
	+28 VDC fuse blown	Replace fuse
	Erratic pulses from pins E, & F of Acc & Dec Gate card (H-5)	Replace card
	Motor Drive card (H-25) not sequencing	Replace card
	XY Relay intermittent	Replace Relay card (H-20)

Table 5-1 Troubleshooting Guide (Cont.)

Problem	Probable Cause	Remedy
11. Table will not operate in Slow or Med Jog mode	No ground level at pin L of Acc & Dec Gate card (H-5)	Check for broken wire at pin L of the card
12. Table will not operate in Hi Jog mode	No +12 VDC level at pin L of Acc & Dec Gate card (H-5)	Check pin X for +12VDC Check for broken wire at pin L. Check for broken wire on Joystick panel
13. Table will not reverse during Automatic mode	.5 Counter card (H-4) defective	Replace card.
	XY Relay intermittent	Replace Relay card(H-20)
	Edge Sensor Card (H-8) erratic	Replace card
14. Table will only take 7 (or 6) steps in Automatic or Manual Index mode	Start/Stop flip flops on Acc & Dec Gate card (H-5) inoperative	Replace card
	Ground level present at pin H of Acc & Dec Gate card (H-5)	Check for broken wire on pin H of the card
	Counter Boards switched	Place Counter Card No.2 in H-2 Place Counter Card No.3 in H-2 Place Counter Card No.1 in H-3
15. Table takes 7 (or 6) steps instead of 1 in Manual Jog mode	Deceleration Inhibit inoperative	Replace Component Board No.2 (H-9)

Table 5-1 Troubleshooting Guide (Cont.)

Problem	Probable Cause	Remedy
16. Table does not remember direction when Joystick is momentarily depressed in Manual Index mode	Index Pulser card (H-11) defective	Replace card
	Component Board No. 1 (H-6) faulty	Replace card
	XY Relay and/or Reverse Relay defective	Replace Relay Board (H-20)
17. Machine will not index continuously when Joystick is held	Index Pulser card (H-11) defective	Replace card
	Component Board No.1 (H-6) intermittent	Replace card
18. Machine will not reset	Index Pulser card (H-11) defective	Replace card
	Component Board No. 2 (H-9) faulty	Replace card
	.5 Counter card (H-4) inoperative	Replace card
19. Table jams at limit	Limit switches misaligned	Align limit switches
	Faulty limit switch	Replace switch
20. Machine will not start in Automatic mode	Start/Stop Relay defective	Replace Relay Board (H-20)
	Component Board No.2 (H-9) defective	Replace card
	Component Board No. 1 (H-6) defective	Replace card
	Z-Stage Drive card (H-10) inoperative	Replace card

Table 5-1 Troubleshooting Guide (Cont.)

Problem	Probable Cause	Remedy
21. Z-Stage does not rise	Z-Stage Drive card (H-10) inoperative	Replace card
	Component Board No.2(H-9) defective	Replace card
	Acc & Dec Gate card (H-5) defective	Replace card
	Start/Stop Relay defective	Replace Relay Card (H-20)
	+5.5 VDC missing	Replace +5.5 VDC Regulator card (H-28)
22. Z-Stage does not lower	Z-Stage Drive card (H-10) inoperative	Replace card
	Fuse blown	Replace fuse
	Broken wire on Z-Stage Solenoid	Check for broken wire
23. Probe does not edge sense	Probes misaligned	Align probes
	Edge Sensor card (H-8) defective	Replace card
	.5 Counter card (H-4) defective	Replace card
	XY Relay inoperative	Replace card
24. No Start Test signal	Edge Sensor card (H-8) defective	Replace card
	Z-Stage Drive card (H-10) defective	Replace card
	Component Board No.2 (H-9) intermittent	Replace card
25. Table indexes to edge of slice in Automatic mode and stops	Edge Sensor card (H-8) defective	Replace card
	Component Board No.2 (H-9) faulty	Replace card

Table 5-1 Troubleshooting Guide (Cont.)

Problem	Probable Cause	Remedy
26. Inkers do not activate	Inkers defective	Replace Inkers
	Inker Card inoperative	Replace Inker card "A" (H-12) or Inker card "B" (H-13)
	2-Stage Shift Register card (H-18) defective	Replace card
	Z-Stage Drive card (H-10) intermittent	Replace card
27. Inkers do not work on 2-behind inking	Component Board No.1(H-6) defective	Replace card
	2-Stage Shift Register (H-18) defective	Replace card
28. Inkers do not reverse	Reverse Relay defective	Replace Relay Card (H-20)
	.5 Counter card (H-4) inoperative	Replace card
29. No High Voltage Enable pulses	High Voltage Enable card (H-26) defective	Replace card
	+5.5 VDC missing	Replace +5.5 VDC Regulator card (H-28)
	XY Relay defective	Replace Relay card (H-20)
	Acc & Dec Gate card (H-5) inoperative	Replace card
30. Microscope Illuminator will not turn on	Component Board No. 2 (H-9) defective	Replace card

SECTION 6

INTERFACE INFORMATION

6-1 INTRODUCTION

This section contains the interfacing information required for the standard Model 1200 machine and the customer's test equipment.

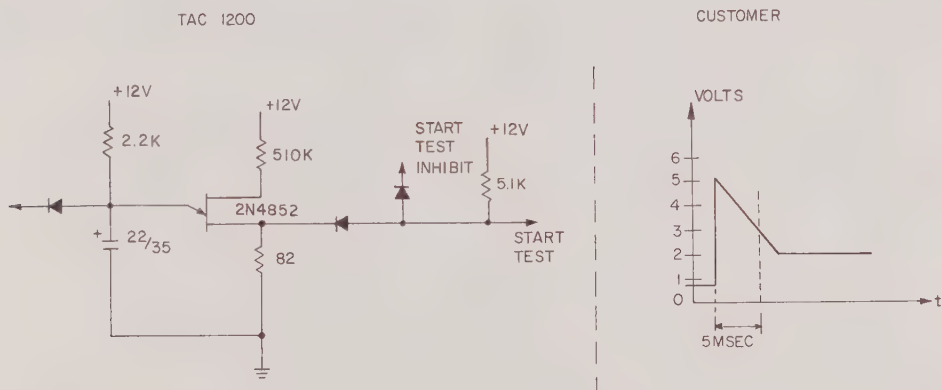
NOTE

The Customer Connector is an Amphenol 25-pin connector type 17-20250.

6-2 START TEST

The START TEST signal to the customer's test equipment appears on the Customer Connector pin #1.

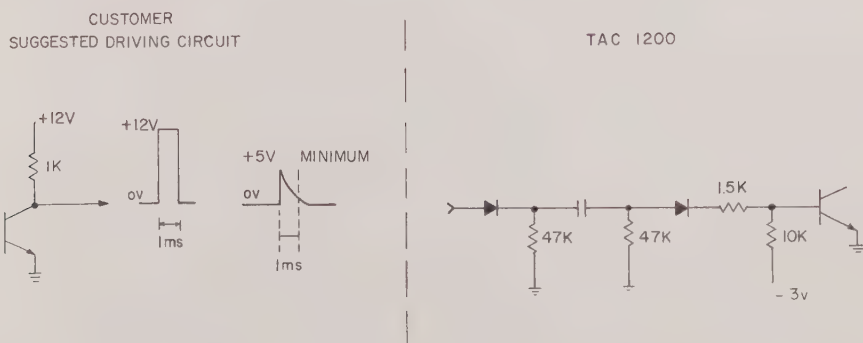
The START TEST signal is capable of driving 5K ohms. The signal is generated by the following circuit. It is recommended that this signal be AC coupled.



6-3 END OF TEST

The END OF TEST signal from the customer's test equipment appears on the Customer Connector pin #10.

The END OF TEST signal must be capable of driving 1000 ohms and have a minimum time constant of 1 msec. The END OF TEST signal must not exceed 30 msec.

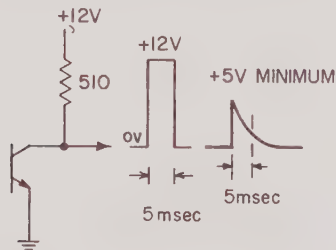


6-4 INKER REJECT

The INKER REJECT signal from the customer's test equipment appears on the following pins of the Customer Connector:

INKER REJECT "A"	pin #25
INKER REJECT "B"	pin #24
INKER REJECT "C"	pin #11
INKER REJECT "D"	pin #8
INKER REJECT "E"	pin #12
INKER REJECT "F"	pin #17

CUSTOMER
SUGGESTED DRIVING CIRCUIT

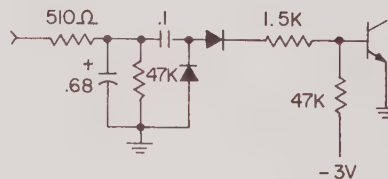


The INKER REJECT signal must be capable of driving 500 ohms and have a minimum time constant of 5 msecs. The INKER REJECT signal must not exceed 50 msecs.

NOTE

The INKER REJECT signal must appear 5 msecs or more before the start of the END OF TEST signal.

TAC 1200



SECTION 7

SPARE PARTS LIST

7-1 INTRODUCTION

This section of the manual lists the available electronic and mechanical spare parts for the standard Model 1200, 1201, 1206 and 1207 machines.

The spare parts listed in Table 7-1 are illustrated and referenced in the mechanical and electrical drawings presented at the end of this manual. These drawings should be referred to when ordering spare parts to ensure that the proper component description

and part number are included on the order form.

When ordering the printed circuit boards, be sure to include the suffix number or letter (70,000 series) imprinted on the actual boards in the machine. If no suffix number or letter is included in an order request, the latest revised board will be delivered; however, this will not affect the machine's operation since all revised boards are compatible with existing boards in the machine.

TABLE 7-1

SPARE PARTS LIST
SEMICONDUCTOR SLICE PROBER MODELS 1200, 1201, 1206 & 1207

<u>TITLE</u>	<u>PART NUMBER</u>
Test Simulator Board	70243
Extender Board	70571
Component Board #2	70680
Accelerator & Decelerator Gated Oscillator & Inhibitor Board	70681
Inker Drive 0-1-2 Step Behind P. C.	70682
Motor Driver Board	70683
Edge Sensor Board	70684
Lamp Driver Board	70685
High Voltage Control P. C.	70686
0.5 Counter & Reverse Relay Board	70687
Component Board #1	70688
Power Supply Regulator Board, +5V	70689
Two Stage Shift Register P. C.	70690
Power Supply Regulator Board, +12V	70691
Counter Board #1 (Standard)	70692
Counter Board #2 (0.5 Mil.)	70693
Counter Board #3 (1 Mil)	70694
Z-Stage Board	70695
Logic Power Supply P. C.	70697
Index Pulser & Logic Board	70698

Table 7-1 (Continued)

<u>TITLE</u>	<u>PART NUMBER</u>
Relay Board	70699
Notch Hopper Adjustable P. C.	70700
Edge Sensor "A" Board (Notch Hopper)	70707
Metric Counter (4 mm) P. C.	70746
Dual Contact Closure Edge Sensor "and" Logic "or" Logic P. C.	70783
Notch Hopper 10 Steps P. C.	70784
5 Pitch Lead Screw Assembly, four inch Travel, Case Hardened	70434-A
10 Pitch Lead Screw Assembly, four inch Travel, Case Hardened	70434-B
2 mm Pitch Lead Screw Assembly, 100 mm Travel, Case Hardened	70434-C
4 mm Pitch Lead Screw Assembly, 100 mm Travel, Case Hardened	70434-D
Cover, Microscope Mount	40396-OP-60
Panel, Side	40395
Arm, Support	40405
Cover, Rear Top	30712
Cover, Dust (Lower)	30714
Disk, Mylar	30749
Cover, Column Opening	30741
Bracket, Connector	20968
Cover, Rear	20967
Bracket, Customer Conn.	20966

Table 7-1 (Continued)

<u>TITLE</u>	<u>PART NUMBER</u>
Lamp, Illuminator	T-1325-L
Cover, Console Front	20949 0P-60
Bar, Panel Mounting	12416
Plate, Connector	12458
Grommet, Rubber	2186
Eyepiece 20XF	31-05-63-02
Pod, Variable Power .7x-3x without eye piece or .75 objective lens	31-26-94
Illuminator Reflector	21423
.75 Objective Lens	-----
Bracket, Logic Power Supply Mounting	21146
Tool Kit	70741
Customer Test Box	70744
Lens, Microscope Mount Cover	12,935
Top Chuck - 7/8 Dia. Hole Pattern	70725
Top Chuck - 1 5/8 Dia. Hole Pattern	70726
Gast Vacuum Pump	1531-V107-288
Cable Assembly In-Place Inking	70820
Eyepiece .25X	1186
Planerizer Box (60 Position)	70936
Z Stage Assembly	70440
Ball Race, Upper	11425

Table 7-1 (Continued)

<u>TITLE</u>	<u>PART NUMBER</u>
Spring Retainer	11424
Screw, Spring Holding	11422
Screw, Airpot Housing	11421
Screw, Airpot Clamp	11420
Cover, Airpot	11419
Center Plate	12807
Ball Race, Lower	11356
Spring Ferrule	11355
Wedge Guide	11354
Yoke	11353
Mounting Chuck, Ring	20931
Diaphragm	11350
Outer Ring	11349
Wedge, Machining	11890-A
Dashpot, Air	303-85-11-656
Solenoid	21362
Spring 3/16 O.D. X .024 Wire X 2/4 Lg.	LC-024B-8
Spring 3/16 O.D. X .024 Wire X 7/8 Lg.	LC-024B-9
Diode	1N4004
Ball, Steel	1/16 Dia.
Screw, Cap	2-56 x 1/2

Table 7-1 (Continued)

<u>TITLE</u>	<u>PART NUMBER</u>
Screw, BD HD	4-40 x 3/4
Screw, Cap	4-40 x 5/16
Cable Assembly	70679
Spacer, Outer Diaphragm	21258
Spacer, Inner Diaphragm	21259
Cover, Dust Upper	30750
Cover (Milled Out)	40394
Microscope and Illuminator Mtg. Ass'y	70457
Block, Microscope Mtg.	40,392
Shaft, Microscope Mtg.	30711
Transformer	T-1238-PP
Vacuum Valve Assembly	70535
Filter, Vacuum	12484
Valve, Toggle	MV-35P
Shaft Bearing	11761
Panel Assembly, Control	70447
Panel, Control	20,9120P-60
Joy Stick	70355-B
Switch, Push Button	2D1
Switch, Push Button	2D28
Barrier, Switch	2B2

Table 7-1 (Continued)

<u>TITLE</u>	<u>PART NUMBER</u>
Switch, Light <i>Switch, Index/Jog</i>	2C9 ✓ 72511
Screen Switch (Stop)	12437-A
Screen Switch (Start)	12437-B
Screen Switch (Step)	12437-C
Screen Switch (Z-Stage)	12641
Screen Switch (Light Override)	12437-E
Bracket Cable	12438-A
Switch, Toggle	7401
Lamp	387
Harness Assembly	70703
Test Simulator Box	70738-A
Lamp	11604
Circuit Breaker	109-205
Lamp	387
Power Supply, Main	70555
Chassis, Power Supply (rear)	40456
Transformer	03-109
Transformer	100-1484
Cable Assembly, Main Power Supply	70706
Power Supply, Logic	70563
Chassis, Logic Power Supply	40467

Table 7-1 (Continued)

<u>TITLE</u>	<u>PART NUMBER</u>
Logic Power Supply P. C. Bd. Assembly	70527
Transistor	2N3789
Transistor	2N3792
Transistor	MJ423
Capacitor 2600 μ f@ 50V	36D2650AB A
Diode	1N1342-RA
Fan	Pamotor 4500
Eyepiece (20x)	31-05-63-02
Chuck Sub-assembly	70441
Retaining Ring	#5101-50
"O" Ring	PRP-568-224
"O" Ring	PRP-568-012
Collar (PIC)	#C1-2
Bushing Bronze	#FB-35-3
Fitting, Tube	340-1-35 & 36
Spring, Preload - Ball - Brg	D6-1
Pin, Chuck	12515
Micro Switch	#ISM1-T
Actuator, Switch	#JS-7
Spring Plunger	#S50N
Pillow Block	11777

Table 7-1 (Continued)

<u>TITLE</u>	<u>PART NUMBER</u>
End Plate	11747
Ball Bearing, Barden	SR6-SS-3
Oiler	11828
Cover, Nut Anvil	11753
Cable Assembly	70696
Slide Assembly, Bottom	70437-A
Slide Assembly, Top	70437-B
Slide Assembly, Bottom	70437-C
Slide Assembly, Bottom	70437-D
Cover, Top-Male	21363
Cover, Top - Female	21373
Bracket, SW Stop - RH	12945-A
Bracket, SW Stop - LH	12945-B
Thomas Flexible Coupling	25CB-12810
Motor Slo-Syn	HS-25
Spacer Bearing	11688-A
Retainer Bearing	11689
Felt Wiper	11756
Nut Anvil	11752
Shaft	11797-C
Bushing, Ball Thomson #OPN-81420-2, Modified per Thomson #3110A	3110A

Table 7-1 (Continued)

<u>TITLE</u>	<u>PART NUMBER</u>
Switch, Push Button	76-2220
Switch, Toggle	7201 with panel dress nut
Digiswitch	8-T-39
Digiswitch	8-T-51
Digiswitch	8-T-50
Digiswitch	8-T-26B
Test Simulator Control BD	70243

APPENDIX A

HIGH DENSITY PROBE SETUP

Procedure

- a. Set the mylar overlay (located at the end of this manual) over pattern of die.
- b. Assign probe positions which pass over die pads.
- c. Turn 60 position ring upside down and turn overlay upside down.
- d. Put probes into position assigned and set X, Y and Z adjustments for midrange.

NOTE

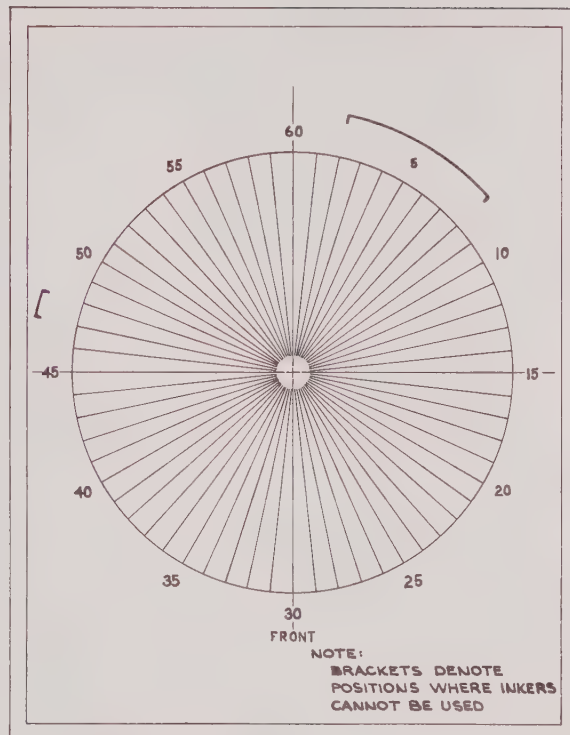
By having ring upside down, you reduce possibility of damaging probe tips and are able to improve efficiency and setup time.

- e. Put probes approximately same height by watching tip holders. Probes should be approximately midrange.
- f. Place probe ring with probes back on machine and position probes over die pad as a coarse adjustment.

NOTE

Make sure slice is aligned in theta.

- g. Use ohm meter or light box to planerize probes to chuck.

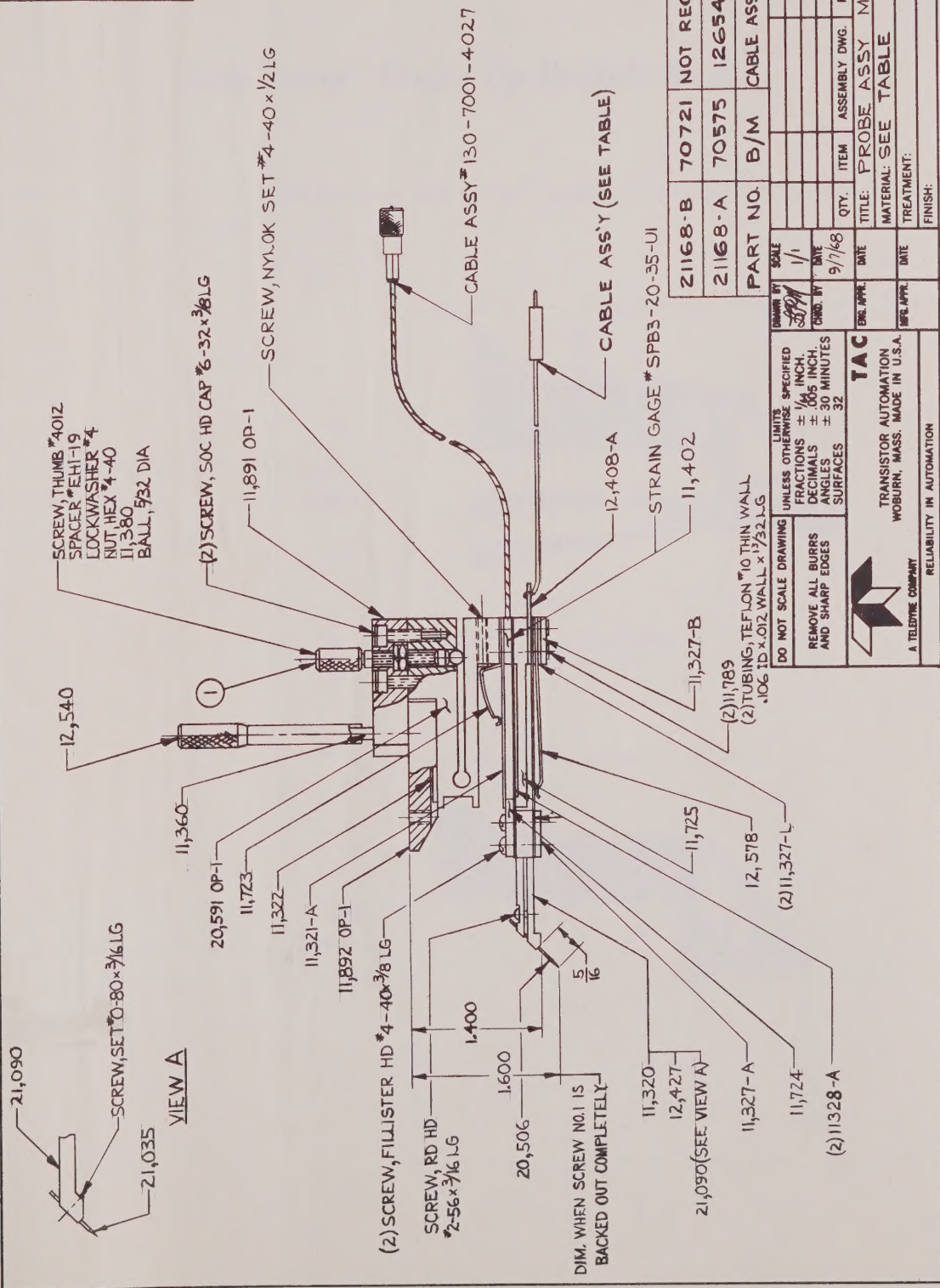


NOTE

By putting one lead to the chuck and other lead to the probe contact, you make a switch out of the probe. By making and breaking of these switches within .0005, you have planerized probes to within .0005.

- h. Reposition probes to die pads.
- i. Chuck and tips to be cleaned prior to planerizing.

REV. NO.	ECO. NO.	DATE	BY
1		9/7/68	JAM
2	1181	9/25/68	JAM
3	1226	10/20/68	D.G.
4	1416	4/8/69	RJB



REV. NO.	ECO. NO.	DATE	BY
1		9/7/68	JAM
2	1181	9/25/68	JAM
3	1226	10/20/68	D.G.
4	1416	4/8/69	RJB

REV. NO.	ECO. NO.	DATE	BY
1		9/7/68	JAM
2	1181	9/25/68	JAM
3	1226	10/20/68	D.G.
4	1416	4/8/69	RJB

REV. NO.	ECO. NO.	DATE	BY
1		9/7/68	JAM
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3	1226	10/20/68	D.G.
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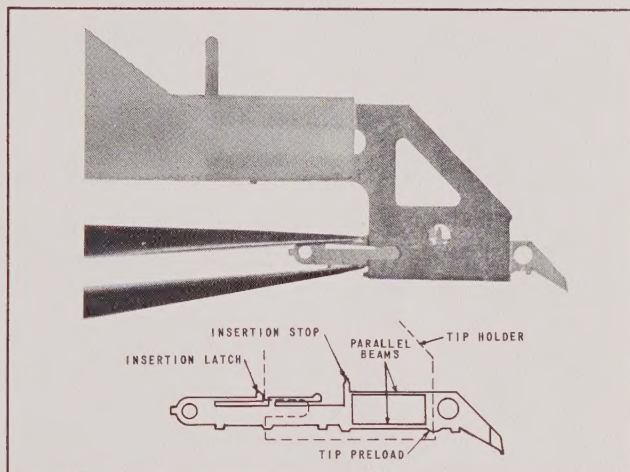
TAC

TRANSISTOR AUTOMATION

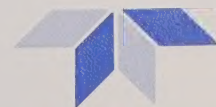
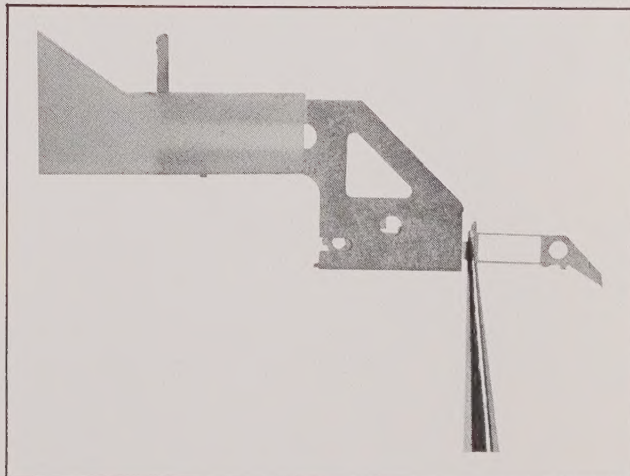
Duo-Beam™ Probe Tip Replacement

In order to avoid damaging a replacement DUO BEAM™ Probe Tip during assembly, the following procedure is recommended.

Depress insertion latch of existing probe tip using needle-nosed tweezers and slide forward out of holder.



Grasp replacement probe tip to the rear of the insertion stop and slide into holder until end hole appears in slot on the rear edge of the holder.



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